

No 24

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MODEL ENGINEERS'

WORKSHOP

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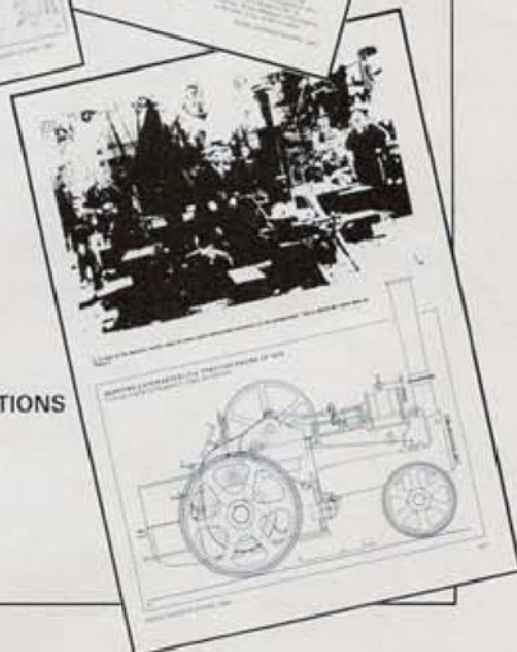
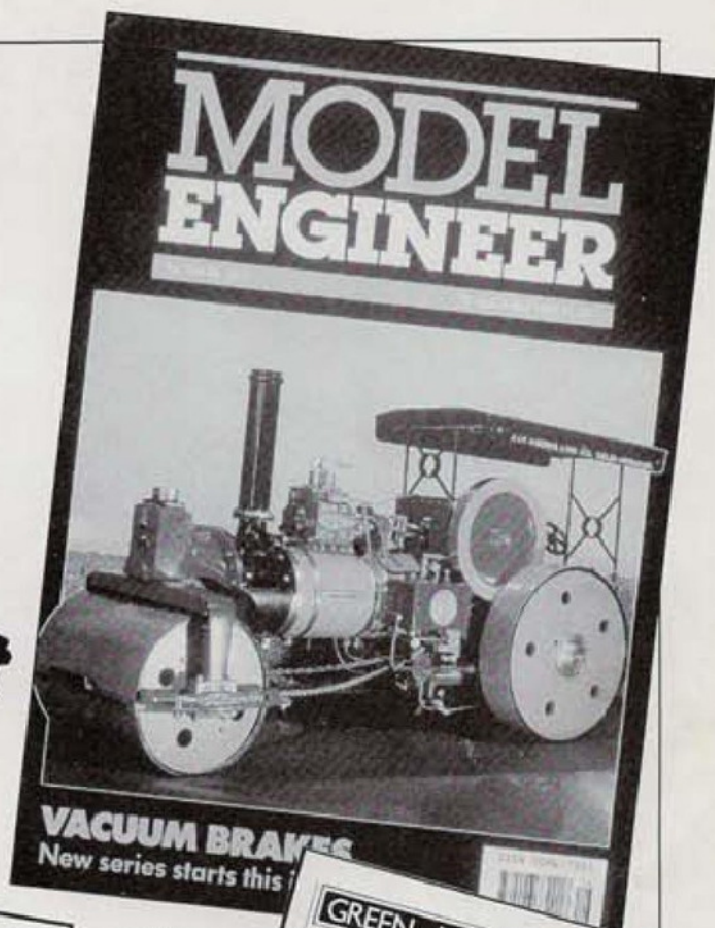
The low-down
on achieving
accuracy



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**SOMETHING
TO LOOK
FORWARD
TO...**
...every fortnight



There's something to anticipate twice every month in fascinating Model Engineer magazine! Whether your interests lie in live steam locomotive models, traction engines, internal combustion motors or stationary engines, world famous M.E. will inspire, instruct, advise and encourage. Model Engineer is published on the first and third Fridays each month and costs just £1.40 from all good newsagents; alternatively, you may care to ensure your regular copies through an annual subscription - a mere £33.60 for UK readers (overseas rates and airmail details on request).

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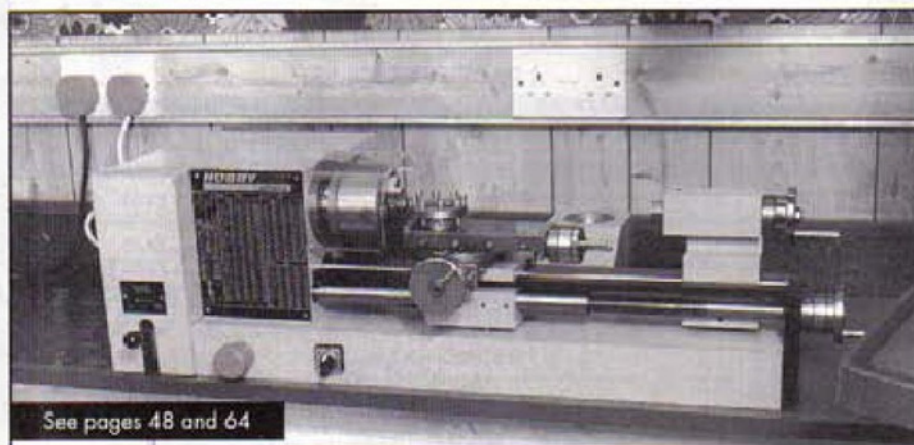
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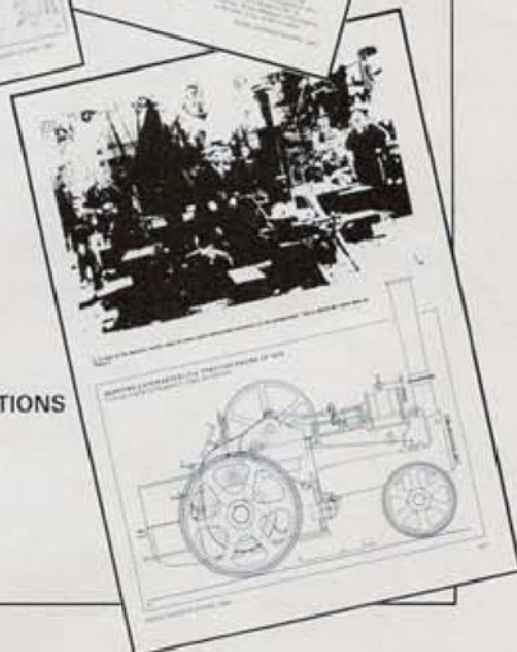
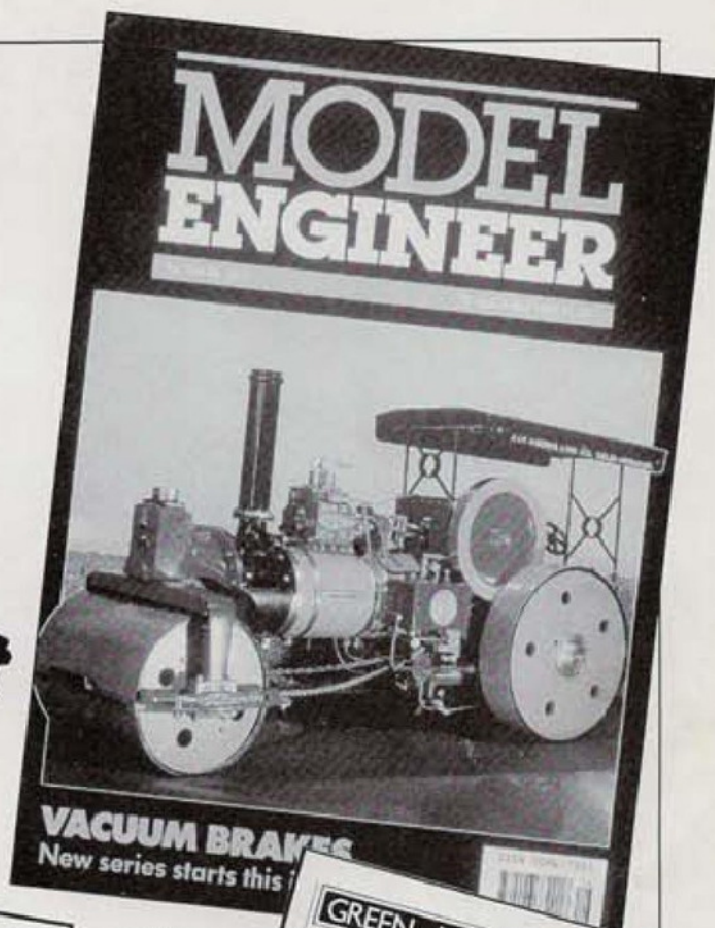
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ON THE EDITOR'S BENCH

One disadvantage of being editor of a magazine with a limited number of issues per year, is that of insufficient space that can justifiably be used in the magazine to take all the peripheral items that one would like to include. The result is, that items worth including may not see print for some considerable time after the idea surfaces. Limited issues also means limited personal time to bring such items to a state of readiness for publication. It is due to this latter point that an item on the very worthwhile activities of the REMAP organisation has not been published. I felt that a page or two, with a few photographs, relating to the achievements of this charity would have been quite justifiable in view of the assistance some readers of this magazine could offer to them. However, time just does not seem to surface for this, so I intend to go into some detail in this editorial.

REMAP

My enthusiasm for this organisation is doubtless due to my having a son who lived for almost 27 years; during which time he was affected by a gradual weakening of his muscles, such that by the age of 12 he was wheelchair bound. I can remember on many occasions finding ourselves in some difficult location, such as a gravel path on a slight incline, and finding it almost impossible to negotiate. Helpful people would come rushing to help, and quickly grab hold of some part of the wheelchair; to their embarrassment it would come away in their hands. Their embarrassment was needless, as the offer of help was always very gratefully received and, with some suggestion as to a better place to grip, the incline would soon be safely negotiated. I tell this story, as on the front cover of the REMAP yearbook which I have, is a picture of a wheelchair quite easily crossing a sandy beach. To make this possible, REMAP have made and fitted extensions to the larger wheels to make them much wider so that they do not sink in the sand.

Another aid illustrated in the year book, this one simpler, is a device to enable a gentleman to continue to play a trumpet after the use of one arm was lost due to a stroke. This aid reminds me of my own efforts to assist my son to hold up a camera so that he could take photographs himself. I am afraid my attempts were not very successful. These are but two examples of the many items they provide, some of which are illustrated in the year book. This incidentally runs to almost 200 pages. Most items are one offs; there is no possibility that they can be made by a commercial organization, and that is where REMAP comes in. REMAP stands for Rehabilitation Engineering Movement

Advisory Panels and was started some 27 years ago.

Its origins are from an engineer working with ICI at Billingham getting together other engineers and handymen to design and make aids for the disabled. At that time, this was predominantly for ICI workers and their families. From this it has grown to a national organization with a few regional organizers and some 60 local panels who actually organize the bulk of the activities. It is still predominantly an organization of professional engineers and craftsmen whose desire is to help disabled persons lead as normal a life as is possible. There must be readers of this magazine who could offer their services to this worthwhile cause and, as a result, gain much satisfaction from the activity. In most cases this is likely to be to make some parts for an aid which has been designed by another, though some may like to also get involved with creating the designs. Having offered your services there is obviously no obligation to do more than time and ability permits, so do not fear being involved by more than you can justify. If you would like to offer your services, even if only a matter of a few hours occasionally, write to - National Organizer, Eur. Ing. J. J. Wright, Hazeldene, Ightham, Sevenoaks, Kent. TN15 9AD. Tel 0732 883818, who will put you in touch with your local panel. A copy of the yearbook can also be obtained from this address price £3.00 inc p & p.

Photocopies of M.E.W. articles

Perhaps I can bring to your attention an extension to the photocopying services provided for articles published. Articles originally published in colour can, if requested, be photocopied in colour, at an extra cost. The cost of copies is as follows: for mono copies, for a stand alone article, or the first part of a series, £2.00. (When a series, subsequent parts are charged at £1.00). For articles published and requested in colour, these charges are £4.00 and £2.00, respectively. The request must be precise, that is actual title of article and issue number. Where the full details are not known and a search has to be carried out, the fee for this is £2.00. These prices are for copies within U.K., for requests from outside, please add 30% to cover additional postage. Also note that supply of photocopies takes on average 28 days; orders cannot be placed over the phone, as the person responsible for this activity is employed part time. Mark your envelope Photocopying Service but do not mention M.E.W. or the letter will be sent on to me creating further delays. This advice also applies to requests for Binders, Special Offers and back issues etc.

Electrical articles

Any reader involved in charitable work in the U.K., probably in some other countries also, will know that it is now illegal either, to sell to raise funds, or give away to those in need, secondhand domestic electrical equipment, unless this has been certified by a qualified electrical engineer. This is a situation that some find difficult to understand, but it is obviously to avoid the question of responsibility should the recipient be hurt, or their property damaged, due to faulty equipment. While I do not think there is any legal requirement preventing a magazine encouraging readers to make do and mend, even with electrical equipment, I feel we have a moral responsibility not to lead unsuspecting readers into possible dangerous situations. I have decided therefore not to publish articles unless the components are adequately detailed, usually with suppliers part numbers. This will not totally preclude the use of secondhand items, but will make this much less likely. Such an article is that published in this issue relating to fitting a No Volt Release DOL starter and foot switch to a drilling machine. This does not quote part numbers as this gives more scope for choice of manufacturer. It does give adequate details to enable a purchase of new equipment to be correctly made. Even with this degree of detail it is essential that the reader is justifiably confident of his ability to install such equipment. If in doubt get a qualified electrician to carry out the work.

Low voltage equipment does not have the same degree of danger as that on mains voltage, but fire can be a potential hazard with low voltage high current sources. I have a few articles that do not come up to this standard which I will be discussing with the authors. For those considering providing electrical articles, these must quote source of supply and part numbers where appropriate. I would suggest the catalogues of Electromail and Maplin as the suppliers of items chosen. Incidentally the Electromail catalogue is now on special offer again. This time at £2.95 up to 31st Oct.

Editorial ignorance

In issue 22, page 68, I published a letter from Gerhard Gunnarsson regarding a small lathe that he had acquired, even though I thought this was a one off and would not bring in any replies, how wrong could I be? The result was a large number of replies, some together with photocopies of illustrations taken from old clock making books. See *Scribe a Line* for a few of these letters.

On a more serious note, a letter from Terry Gould in issue 18, relating to legal and insurance requirements when storing and using gas on domestic premises, has brought in a number of letters with differing views from those aired by Terry. Some of these letters are published in this issue. While I endeavour to ensure information published is correct, I feel all readers will appreciate that I am unable to be knowledgeable on every subject. I would like to make it clear therefore that all letters published are the views of the writer, and not necessarily of myself or the publishers.

STUDS AND DOWELS

Mark Burgess provides this short article on the subject of designing with studs and dowels.

The humble nut and bolt are used extensively in engineering for the effective assembly of components. If access to some faces is difficult then the bolt may be inserted into a tapped hole in (usually) the larger component. However to avoid wear and possible damage to the thread it is better to use studs and nuts. A stud is essentially a piece of round bar threaded at both ends, but there are certain principles that should be observed.

required, on steam engines, i.e. engines etc.

As regards the positioning of holes, some authorities state that the hole centre can be $\frac{1}{4}$ of the diameter from the edge of the parent metal. I think this is rather close and would suggest $\frac{1}{2}$ of the diameter as the absolute minimum, though a distance equal to the diameter looks better and allows room for a washer (diameter usually about $2D$) under the nut. **Figure 1**, drawn to scale illustrates these points.

The length of stud protruding from the casting obviously depends upon the thickness of the components being attached, but due allowance must be made for nut, washer and gasket (if any) plus half a stud diameter (**Figure 2**).

Dowel diameter

Dowels not only offer accurate location but are also stronger in shear than bolts of the same diameter (and material). This is a useful property when, for example, shock loadings are envisaged. The dowel diameter is usually the same as that of the fixing bolts, the theory being that if M8 bolts are required to fasten two components together then there is little point in using 3mm dowels (unless there are space problems). See **figures 3A & B**.

It is important to remember that the shear strength of a dowel is proportional to its cross-sectional area. The temptation to use two 3mm diameter dowels in place of one of 6mm must be resisted. If you halve the diameter the cross-sectional area is reduced by a quarter e.g.

6mm diameter area = approx. 28 sq. mm.

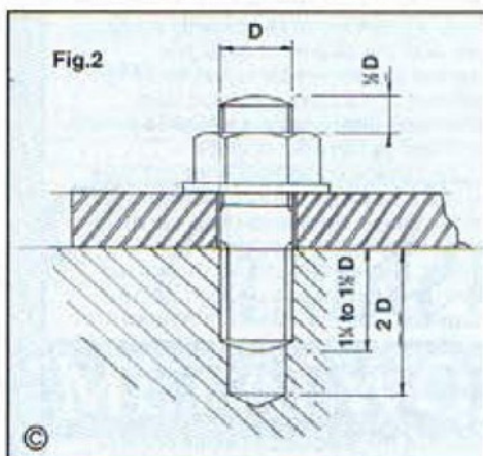
3mm diameter area = approx. 7 sq. mm.

(Two 4mm diameter dowels would be better. Total area approx. 25 sq. mm.)

Dowel Length

The portion of dowel that will fit into the hole should ideally be about $1\frac{1}{2}$ times the diameter, though obviously the thickness of the fitted components is significant. Excessive length will not provide any appreciable benefit, and the pins will be more susceptible to damage (particularly

Fig.2



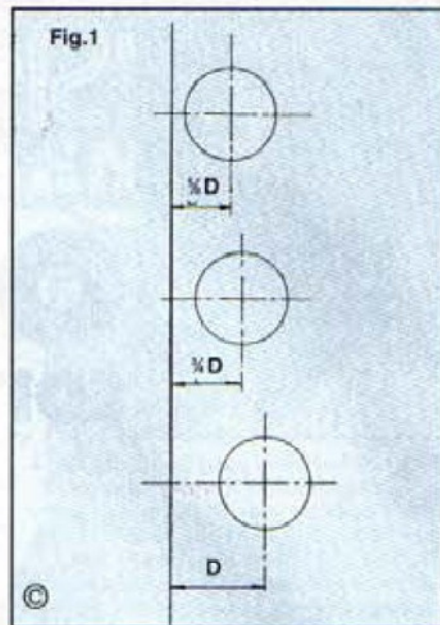
The stud

The fixed end of the stud usually has a coarser thread than the nut (because the main component is often a casting which has a larger grain size than a rolled material). Although two different threads are used they should be the same system, i.e. BSW and BSF, UNC and UNF or metric coarse and fine. Not metric one end and BSF the other!

Theoretically the fixed end need only be threaded for a length equal to its diameter but $1\frac{1}{2}$ to 2 times the diameter is usual. However due reference must be made to the materials concerned, so where a stud has to be fitted to a soft material, e.g. aluminium alloy then the depth of engagement should be increased to 2 or even 3 times the diameter. If this rule is not observed then the thread in the parent metal may strip when the nut is tightened.

The tapped hole should be drilled to a depth of at least twice the diameter, greater of course if the stud is inserted more than $1\frac{1}{2}$ diameters. As it has been mentioned in *Quick Tips* in *M.E.W.*, it is a good practice to lightly countersink the hole to prevent the edge 'Pulling up'. This is particularly important where a gas tight joint is

Fig.1



Dowels

It has already been stated that studs offer certain advantages over bolts in terms of reducing wear and damage to the threaded hole. Studs are also useful for locating components, and ease assembly, particularly if several items have to be fitted together. However it is not possible to position a stud accurately in a threaded hole, though the tapping hole may have been drilled precisely there is no guarantee that the subsequent tapping operation will be in line. If precision is required (or studs are not practical and bolts must be used) then location can be achieved using dowels. These are basically pegs fitted to one component which engage with corresponding holes in another, thus ensuring repeatable accurate alignment every time they are assembled. This feature means that they are frequently used in Horology (the science of clocks and watches) where they are known as steady pins.

There are certain conventions which are usually adopted to ensure efficient operation and these are detailed below.

Fig.3A

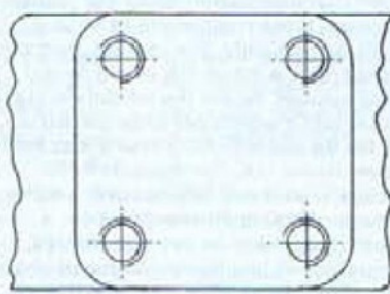
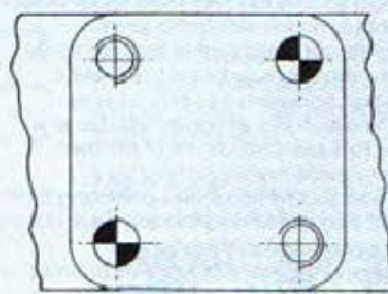


Fig.3B



4 x M8 bolts

2 x M8 bolts
2 x 8mm dia dowel

If the load is only in the X and Y directions, then 3B is the better engineering solution

bending). Shorter dowels may be acceptable if the components are only to be fitted once and the dowels do not take any load, being used purely for location.

Dowel Materials

Some authorities recommend that all pins should be hardened and ground, the theory being that the hardened surface offers improved wear resistance and will also be less prone to sticking to the fitted component. If the dowels are used to locate the two halves of a high usage press tool then the above will be the optimum solution.

In some situations bright mild steel may be adequate but for most applications silver steel (or similar) is preferred.

Dowel Positions

For location, the pins should be placed as far apart as is practically possible. Usually two pins are sufficient through there are instances where more may be required, if the part to be fitted is prone to distortion (a large thin pressing for example).

Some important principles are demonstrated in **figures 4A-D**. First of all, if only one dowel is specified then the fitted component cannot move in the 'X' or 'Y' directions, however it can rotate (direction 'R'). If the second dowel is fitted at 'P' then the necessary clearances mean that any movement between the dowels will be greatly magnified at 'Q'. The second dowel should therefore be fitted at 'Q', but it is still only preventing rotation so it can actually be modified as shown in **figure 4D**. The faces which locate on the hole should be at least two thirds of the diameter and obviously oriented to resist rotation of the components. Notice that the minimum amount possible has been removed from the curved face. Only sufficient to ensure clearance, thus maintaining the maximum cross-sectional area of the dowel. Incidentally this modification also permits easier assembly with little detriment to performance. The comments and diagrams (4A-D) may seem obvious but it is surprising how often they are not observed.

In applications where dowels are fitted to resist a load, then they should be positioned as close as possible to the line of action of the force. The milling machine stop as described by the Editor in *M.E.W.* April/May 1993 is a good example.

Fig.4A One dowel fitted - movement restricted to rotation

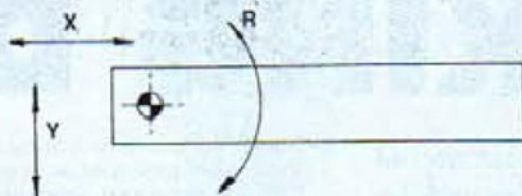


Fig.4B Two dowels fitted close together

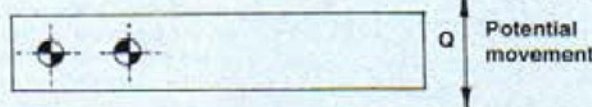


Fig.4C Two dowels fitted wide apart

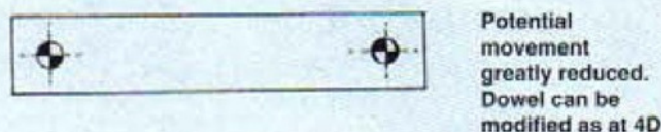
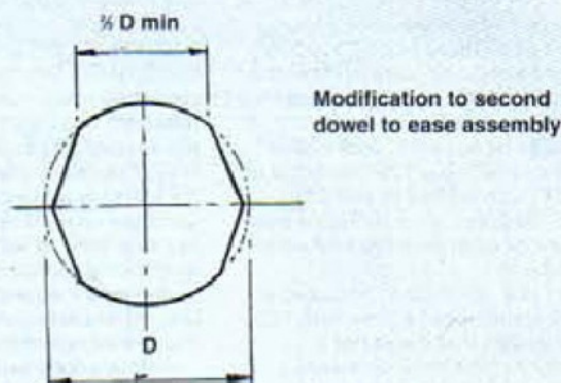


Fig.4D



Fitting

Drill the clamping screw holes first and check the position of the parts before drilling the holes for the dowels. If possible, drill through one component into the other (or use a jig) to ensure accurate alignment. The 'open' hole should be drilled undersize, then reamed to the correct diameter. Also ensure that the dowel holes are perpendicular to the mating surfaces or the parts may not fit together. One end of the dowel is usually fixed so it should be made an interference fit and then pressed in. If it should ever work loose it may be possible

to secure it by knurling the end and then refitting. The 'free' end of the dowel should have a slight chamfer with a corresponding light counter sink on the hole. This not only eases assembly but also reduces the risk of damage to the fitted component.

Finally, it must be remembered that while dowels perform the functions of location and resistance to shear, they do not secure components. There is no clamping effect, particularly important if the load is in three axes or a joint is subject to fluid pressure, e.g. steam, internal combustion and hot air engines.

MEW Index Update

In *On The Editor's Bench* in the last issue, I placed a request for readers to assist me in testing the new computerised index for *MEW* before making this available for readers to purchase. I had anticipated that there would be more offers than I needed, but the scale of this excess has been a considerable surprise to me. As I write this, the magazine has only been available for around three weeks and already the amount of replies has been many times greater than on any previous subject. This situation makes it very difficult for me to answer each one individually. I would like therefore to thank

all those who have sent in and say how much your offers of help have been appreciated. Quite a few took the opportunity to comment on other matter and I will be replying to these in due course.

The programme for the index is now largely completed and I will be sending copies to a few of those who wrote in for their comments. I anticipate that perhaps some of their comments, where appropriate, can be published in the next issue, and a printed index for the past two years to be included in the following one:

The system comprises six individual indexes and these are Articles, Quick Tips,

Letters, Trade, Subjects and Workshop items published in *Model Engineer*. They can also be combined to be displayed in groups of two or more indexes as requested by the viewer. The displays provided are in order of area of activity, chronologically and by author. However, a facility is also available for them to be sorted and displayed in any possible combination. They can be printed out in every format and for one issue, one year, any period of time and for all issues published.

Editing of records is possible and also additions for new issues of the magazine. However viewing and editing are kept separate to avoid the accidental corruption of index data when viewing.

More details in the next issue.

MAKING DIVISION

With the new commercial production methods for making division plates, they are now much more affordable. Even so, there are still many numbers that are not available, and making one is the only way out. George Swallow describes how he set about making a plate for that frequently missing number, 125. The method is however, suitable for any number.

Some years ago, when I was making the Dore-Westbury milling machine, I bought a division-plate to make the feed-screw dials; to this day the vertical-feed dial is still graduated in 5-thou. spacing because none of the stock plates on offer at that time had a 125-hole circle to match the 8TPI worm; I had to settle for one that had 100 holes, even though it also had a selection of what then seemed very unusual numbers.

At the next M.E. exhibition I enquired at the supplier's stand about a plate with 125 holes and I was told that it was not a number of any interest to clockmakers, who were practically the only customers for plates with large numbers. However, the one I had already bought could be drilled on the back with 125 holes, at a setting up charge of so much, a rate per hole, postage and packing and then VAT on all of it, coming to a staggering sum hardly less than the cost of the original plate. This provided the spur to make one instead.

Searching back amongst old M.E. magazines suggested several methods, including the use of trains of lathe change-wheels, circles of turned bushes, and perforated tape on a wooden wheel. The last of these seemed the most promising for large numbers and the least trouble,

bearing in mind that the making of tools was not at that time seen as an end in itself.

However, there were snags in this method, as in the others. The usual arrangement showed the wheel with the tape on one end of the headstock, whilst the division plate being made was attached to the faceplate at the other end. The holes were drilled using a drilling spindle mounted on the cross-slide and driven independently by belts coming from somewhere up above. I had no drilling spindle and nothing above my lathe except air.

The solution devised was to attach the plate blank to the same wheel as the perforated tape, to do all the drilling on the drilling machine, and to use the catch-plate (minus the drive-pin) instead of the larger face plate. As so often happens, there is no small simple job that cannot with further thought be made into a large difficult one, and it was decided to make enough plates to cater for all imaginable future needs, including the possibility of getting bitten by the clock bug. For the numbers, the Chronos catalogue was a valuable source of reference and I worked out that three more plates would be enough to provide all the holes needed, the largest being 144. One of the plates would include some of the low numbers up to thirteen, and anyone who has ever tried to index four holes 90 deg. apart using a circle of a hundred will understand the need for this one. I always lock my workshop door when I am dividing and I recommend this habit to everyone.

Before a start could be made, a great deal of calculation was necessary, based on the diameters of the finished plates, the maximum and minimum sizes of wooden wheel that could be turned, and the numbers of holes required in the plates. Obviously, the large numbers must be nearest the outside edges to avoid the holes running together, but the other snag is that the wooden wheel cannot be turned much below the diameter of the plate attached to it.

From these calculations, the hole spacing and the distribution of the numbers between the plates was decided (see the Table) and the plate diameter was fixed at just under 6 inches.

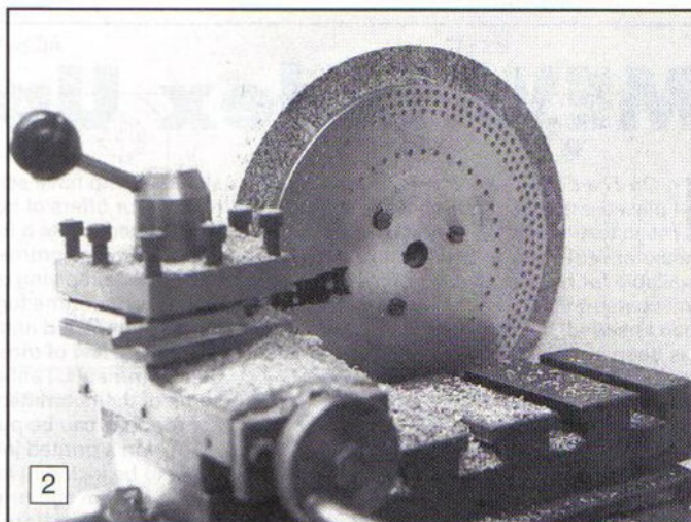
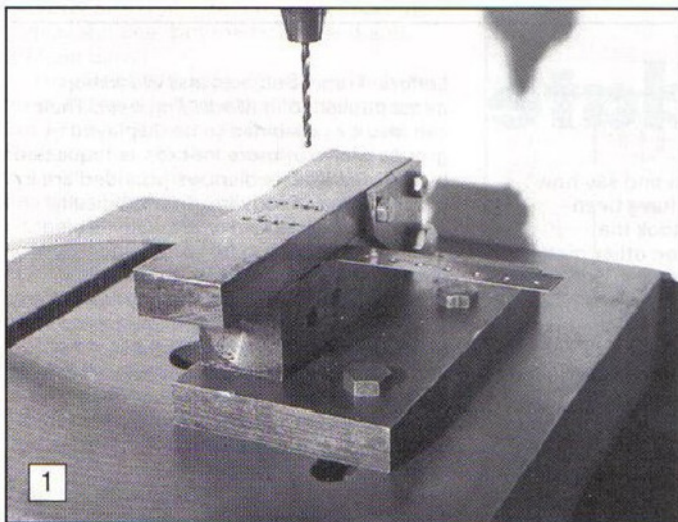
I already had one plate, but the attached table of numbers shows this as well as the new ones. It should be stressed that the wheel sizes shown in the Table are only for rough guidance; their calculation depends on the exact hole-spacing on the tapes found afterwards by measuring them. The purpose of producing the table is to show what must be done to plan all the turning/drilling in the right order. Once bits have been snipped off the tape, they cannot be put back again!

Construction

The first stage was the production of the perforated tape, and it should be stressed that a jig is essential for the drilling, both to obtain the correct spacing and to have the holes in the tape truly aligned. Basically, it is a milled channel the width of the tape, with two holes along the middle, one aligned vertically with the drill and the other holding a peg that fits the previous hole drilled to determine the spacing. The milled channel and the holes (or centre pops for them) in the top of the jig should be made with the same setting of whatever method is used, a miller, a vertical slide, or an angle bracket on the cross-slide. If the holes in the jig are misaligned, the tape will progressively bind in it as the holes are drilled. In use, it is advisable to have the jig clamped to the drilling machine, as two hands are hardly enough even with this done.

The jig in **photo 1** has a hinged top section to guide the drill, and is probably more elaborate than it needed to be, with holes at many different spacings. I should perhaps confess that in my case the admirable forward planning mentioned earlier didn't start until after the jig had been made! If the top guide is dispensed with, then a centre-drill of the same diameter as the peg must be used to drill the tape to ensure accurate spacing.

It was hoped that a single tape could be used for all of the wheels but this was found not to be possible. The maximum size of wheel that could be turned, and the minimum fixed by the plate diameter, meant that some of the middling numbers



PLATES



needed a different spacing on the tape to keep the diameter of the wheel within these limits.

The tape used was a length of half-inch wide steel of the kind that is used for putting round packing cases and pallets of house bricks. Mine was found in an unattended building skip, and this may still be the best source of supply. I have never found it on sale; it is ironical that when you do come across some, you usually find about twenty feet of it! Thin spring steel could be used if it is annealed first.

Once the jig is made, the holes in the tapes can be drilled, a little beyond the maximum number needed, and one end marked as the beginning. The holes should then be counted, using dividers set to span eleven holes, and the tape dot-punched at every tenth hole. In the marking, the very first hole is ignored as it will always overlap the last one. This counting and marking is vitally important, as the marks are used as a guide to shortening the tape to exact numbers for each row, which are sometimes multiples of the number of holes to be drilled in the plates. The beginning of the tape should be drilled near the edge with a small hole for a panel pin.

The next job is the roughing out of the wooden wheels, for which white-faced chipboard was found ideal (you can write on it). The sawn blanks are attached in turn to the faceplate and drilled with a 1/2 in. drill. The hole can then be opened up to a recess about 1/4 in. deep to be an exact and tight fit on the catch-plate with the drive-pin removed. Some people may hate drilling holes in their catch-plate for the screws, but my catch-plate has never been used for its intended purpose and is far too clumsy for any centre-turning I have ever done. I therefore had no regrets about drilling holes in it.

The middle of the recess should then be deepened by about half the depth of the remaining wood to a diameter a little over the diameter of the centre-hole required in

Table of Numbers – Example						
(Order of Drilling)						
Tape 1 (3/16ths Spacing)	Tape 2 (1/4" Spacing)	Existing Plate	New Plates			Approx** Wheel Diam (Inches)
			Plate 1	Plate 2	Plate 3	
144		72	144			8.59
140			70		7	8.36
132			132		11	7.88
	98			98		7.80
127				127		7.58
	96	96				7.64
128		64				7.64
126			63			7.52
125				125		7.46
124		62				7.40
120		60	120		12	7.16
	90			90	9	7.16
118		59				7.04
	88			88		7.00
116			58			6.92
114			114			6.80
112			112			6.68
	84	84				6.68
	82			41		6.53
108			108			6.45
	80	80			8	6.37
	78	78			13	6.21
102			51	34		6.09
100		100			10	5.97
	75			75		5.97
	74			74		5.89

the plate. This is to avoid running the boring tool into the catch-plate later.

Assuming this brave act over the catch-plate is accepted, the wheels can be mounted on it one after the other with screws, the catch-plate well bedded down in the recess. The outside diameter can be cleaned up and a couple of circles gashed in the face of the wood with a pointed tool to assist the attachment of the plate centrally, but no facing should be needed.

Photo 2 shows a wheel being turned on the outer face ready for a further row of holes in the dividing head to be made.

Brass is best for the plates but expense may dictate steel or aluminium, and 4mm thick is enough. The plates should be sawn roughly to a circle and three or four holes

should be drilled on a circle near the middle of each plate for attachment to the wooden wheels. Again, no facing of the plates should be necessary but they can then be turned to size and the centre hole bored through, using a turned plug as a gauge to ensure the same sized hole for all of them. I trepanned the outside diameter of mine from the square but this should only be done if the waste portion is also screwed to the wheel for safety. At this point it is a good idea to number the wooden wheels and to mark on the back the number of holes for each successive row and to write down the length of the tape to produce them. *From here on, each plate remains attached to its wooden wheel until it is totally finished.*

The tape should be snipped to the first length, the first hole that was not counted being an overlap when fixing it to the wheel. Turning of the wooden wheel to fit the tape can now start. It is unlikely that anyone has equipment to measure such large diameters accurately but this is not necessary. Instead, wrap the tape round the wheel occasionally and use Vernier calipers when getting close to measure the distance between the centres of the holes that should register together; this distance, divided by 2π is the maximum advance of the cross slide that should be made for the next cut. Care is needed but not breathtaking precision.

If you have used chipboard, this process makes lots of flying dust, and wearing safety spectacles will reduce the interruptions. Once the right size is

reached, gash a shallow groove on the outside diameter where the holes in the tape will fall and then attach the tape. Whilst holding it with a peg of the same diameter through the overlapping holes, drill the panel-pin hole through the other end of the tape and pin through to the wheel.

The whole assembly can then be taken off the catch-plate and transferred to the drilling machine. Here, a spigot of the same size as the hole in the wheel is fixed to the drill-table as a fixed pivot, with a detent similarly clamped bearing a peg for the holes in the tape. As can be seen in **photo 3**, I used a hacksaw blade to hold the indexing detent, held in place by G-cramps.

The drilling must be done with a centre drill for rigidity and it is then just a matter of revolving the wheel to suit the number of holes being drilled, moved the drilling-

table sideways to the position designated for each row. Once the full circle is drilled, the tape is taken off, the next wheel screwed to the catch-plate, and the process begins again. The holes do not need to go right through the plate unless deburring a thousand or so holes is expected to be an enjoyable occupation. The last stage is to stamp each plate with the number of holes contained in each row and to deburr the back outside edge of the plate. Regrettably, opening up the clockmaking possibilities with these plates proved too much of a temptation for me, and the next project became the clock-wheel cutting engine pictured in Alan Timmins' book on his 8-day long-case clock. This, and using it afterwards, provided more reasons is still graduated in 5-thou spacing!



A SIMPLE STEADY

A travelling steady is probably one of the lesser used lathe accessories, but nonetheless essential when the need arises. Alan Jeeves suggests some simple approaches to the problem. This, with the variation suggested in the postscript, should prove adequate for the majority of instances where this form of steady is required.

Here is a very simple little steady for use on the lathe. Many small lathes are purchased without a travelling steady within the accessory kit and a bought-in steady may be expensive or even obsolete as with some of the older lathes.

In many cases it is not necessary for this type of steady to be of greatly robust construction, all that is required is to provide support for the turning of small diameter work (or to assist in the cutting of small screw threads) when the machining is to take place over a relatively long length

of the workpiece.

My own lathe is such a machine, where a standard travelling steady was not obtainable as the manufacturers – Henry Milnes & Co. – have long ceased making machinery. It is my intention, one day, to make this piece of equipment to fit my particular lathe but until then I have 'made do' with the elementary device described here, and I have achieved much success.

I am fortunate in that my toolpost will accept tools up to a height of 20mm and so when using smaller tools I have plenty of room underneath the tool to trap the

steady (**Fig.1**). On some of the smaller lathes, however, the toolpost may have to be removed altogether to fit it. I therefore offer an alternative method of mounting (**Fig.2**) for users with the 4-station type of toolpost. The general idea may inspire many to produce this useful, easily made, and cheap tool to suit their own requirements.

As can be seen from the sketches, the steady is really only a piece of mild steel strip which is bent or machined at a right angle. I used a piece of unequal angle iron for mine. The strip should be wide enough to position the tapped hole for the brass screw where required in the horizontal plane. Into the tapped hole is fitted a brass set screw which has had a flat nosed point turned onto it. This screw bears against the work and supports it during use. An optional locknut can be provided at 'x' if preferred. The tapped hole must be drilled carefully on the same centreline as the centre height of the lathe.

An alternative idea

If the second option is taken up (**Fig.2**) the clamp screws may need to be extended in length to accommodate the locknuts, and the tapped hole will have to be precisely positioned also. No dimensions are included as these can be scaled to suit the user's preference.

(In the case of **Fig.2**, a second support screw could beneficially be fitted in the long arm at right angles to the first. This would give improved support to the work being turned. – Ed.)

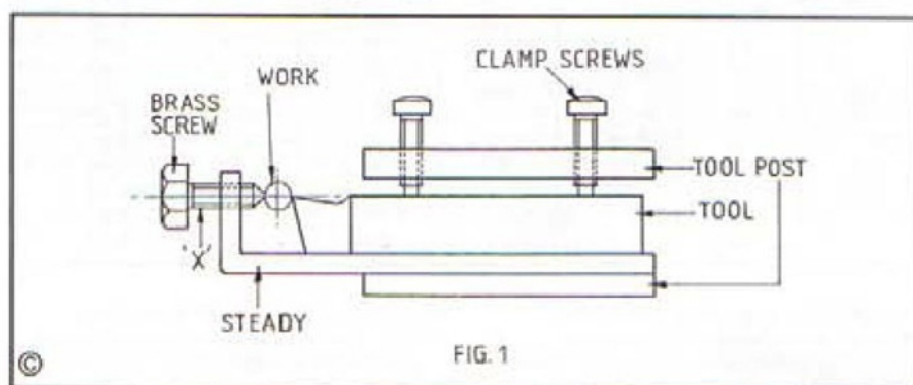


FIG. 1

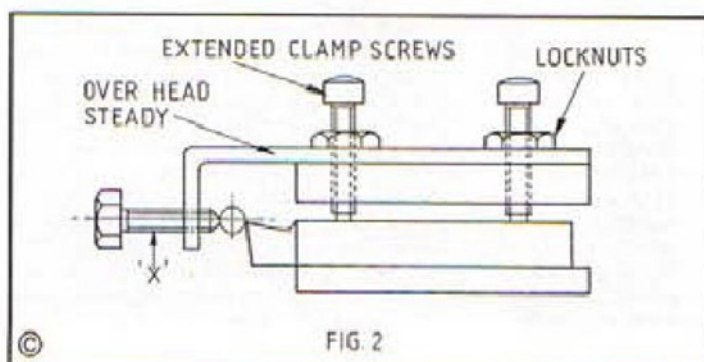


FIG. 2

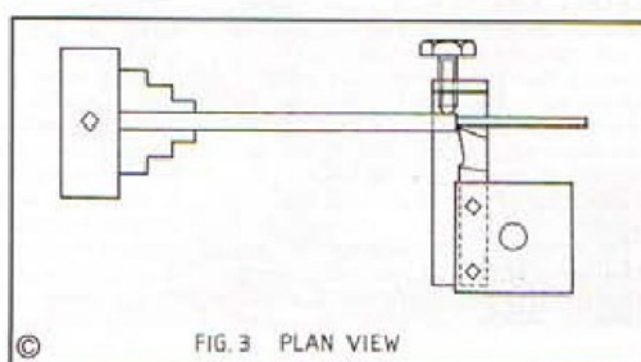


FIG. 3 PLAN VIEW

LINK UP

**Reader to reader service – help
– queries – small sales – wants
– and it is all free!!**

WANTED

Wanted; Fixed steady for Raglan "Little John" lathe required, also any other spares for same. Tel. (0977) 519906.

"Help" I have an Emco Maximat V10P Lathe.

I lack experience in using it. I wonder if there is anyone within the Colchester area who would help in giving me some advice and tips for the lathe.

My name is Terry, on 0206 845145.

Hello, I am looking for information on fabricating low cost plastic injection molds. I need information about cast zinc "Zamak" molds, Kirksite molds, epoxy molds or any other interesting methods. Also plans for a homebuilt injection machine and EDM machine. I need to make prototype parts for a model project.

I also am interested in press forming glass lenses and need to get information on molds and pressing technique.

Any personal experience on forming plastics, glass or sheet metal would be appreciated. Thanks.

Chris Morley
Box 1705, Redondo Bch,
California, USA, 90278
Tel: 310-371-3919
Fax: 310-371-4827

I have a number of small machine tool items that are not compatible with my Super 7 and Centec 2B. I would like to exchange these. I have:

a) A 9" dia. C.I. Rotary Table, ungeared, graduated 0 to 360 degrees. I require an up to 6in. dia., geared or ungeared table.

b) A Dividing Head, 5 1/2in. centre height, 1:40 worm, division plates with 18 sets of holes, 3MT spindle with 8TPI x 1 1/2in. nose, plus two tailstocks. I require an up to 4in. centre height geared dividing head, preferably with tailstock.

Hall 0926 624456 (Warwickshire).

Wanted for early Unimat SL (spindle thread M12 x 1), 4 jaw independent chuck, steadies, milling table, what have you? Please write or phone Pete Donohue, 69a Eastern Avenue East, Romford, Essex, RM1 4SD. Telephone 0708 728087.

Does anybody in the Newbury area have foundry facilities? I need to make some cast aluminium components for the renovation of a Jaguar Mk V Saloon. Call Dick Clements on (0635) 521842.

It's always a drag to wait weeks for a letter from friends too far away to telephone but electronic mail is a different

kettle of fish. I would be interested in corresponding via E-mail with any other model engineers who are able to do so. I am currently trying to find information on model steam turbines, flash steam engines and pumpkin throwing catapult designs (I).

My E-MAIL name is: "steamer@rain.org" and my "ordinary" name is Edward T. Haas. I'm also the instigator of the SBSMEEBBO (Santa Barbara Society of Model & Experimental Engineers & Barbecue Club).

I am interested in two attachments for use with an arc welder as seen in the Frost restoration catalogue. However, these, or similar products, do not appear to be available in Australia. As postal charges between UK and Australia can make purchases expensive, I would like to learn more of them prior to making a purchase. Does any reader have any experience that they could share with me, either of these or similar items.

The products in question are, 1. Body welding attachment using a pulsating action for thinner materials, and 2. Spot welding gun which can produce spot welds from a single side. Frost's part numbers are W170 and W160. Amos, 6 Cardinia Road, Mosman 2088, Australia. (02) 969 9057.

Wanted to buy or borrow book called *Introducing Model Engineering* by H R Hadlow. Also original plans for Stuart Twin Launch Steam Engine 1 inch bore approx circa 1910-1920. Any info on these items greatly appreciated. Tel: Guernsey 0481 726168 and I will phone you back on receiving your number.

Can anybody tell me if change wheels from any other lathe can be easily modified to suit a Raglan. Tel: 0543 378651 or write to J Bennett, 67 Pelsall Road, Brownhills, West Midlands WS8 7DL.

Wanted any information about the Myford ML2 lathe. Also 4 jaw chuck for same. Mr A Braxington, 90 Denbigh Street, Stoke-on-Trent, Staffs ST1 5JB. Tel: 0782 285775.

I require 6ft. lengths of 18 swg stainless steel strapping 1 1/2in. wide. Can any reader offer some, or suggest a possible source. Aptin. Tel: 0305 269770.

Could anyone help me find a good secondhand single or 4 way tool post for a Colchester Student 6in. lathe (the older type). If anyone has a spare tool post please contact me. Tel: 0849 46634.

I have a knee type horizontal bench milling machine, table size 3 1/2 x 16in. Cast in the body are the words: The Burke Machine Tool Co. Con ATO, U.S.A. There is also a metal label which reads supplied by George H. Alexander Machinery Ltd., Engineers, Birmingham. I would like to know where I could buy spares, accessories, handbook or any information. D. Lambert, 33 Holme Lacy Road, Hereford HR2 6DD.

I am looking for leadscrews dials (Imperial) for Ajax bench milling M/C model No. AJ8 and M/C no 6593 as seen in the photograph. Tel: 0533 707618 (after 6pm).

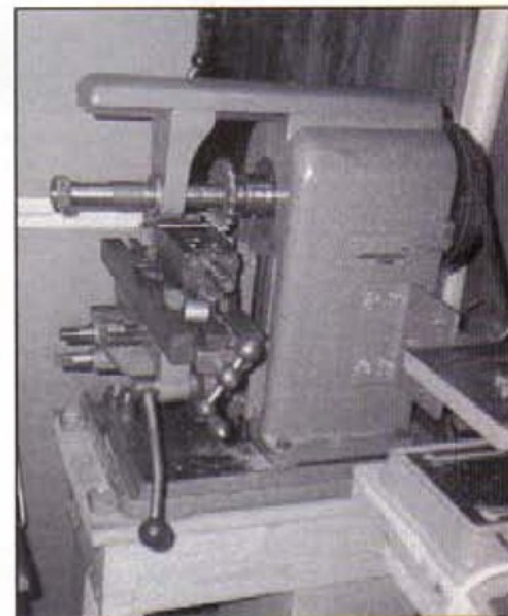
Wanted a T slotted cross-slide to fit an Atlas 5in. lathe. Tel: 0460 64376.

I have a hand cranked round bed lathe by Barrmor Tool Works, Easdale, Scotland. It is called a Rollo Elf. Can anybody help with any information or manuals of any kind. Mr. J. Keen, 12 Honeysuckle Road, Bassett, Southampton SO16 3HY. Tel: 0703 676407.

Can anybody help me. I acquired a small milling machine, the name is Ajax Machine Co. Ltd., Halifax. Has anybody got a manual that can be photocopied and I will pay postage and photocopy charge? I am in the process of restoration. Tel: 0543 378651 or write to 67 Pelsall Road, Brownhills, West Midlands WS8 7DL.

I have burnt out the motor on my "Unimat 3" on three occasions, due to excess continued use. Is it possible to re-motor this unit with a more robust motor and still retain its versatile features of lathe speeds, drill and milling. I F Carver, 8 Universal Close, Whiterock, 4868, Cairns, Queensland, Australia.

Having over the past 3 months acquired all the issues of *M.E.W.* available through Argus Publications I am looking to acquire issues 2, 4, 5, 6, 7, 8, 9, 10 and 13. Important that any issues which can be provided include covers, advertising and pull-out plans and that they should not be cut up. Living in the U.S. all of the above elements include valuable information not otherwise readily available to me. I also badly want to acquire any of the books authored by "Duplex" as Ian Bradley and Norman Hallows as published by Percival Marshall & Co. Ltd. in the early 1950s. Finally, no longer available from Argus Plans Service, I would like to acquire a copy of Plan MM-195 Micrometers. Anthony D Rhodes, 2220 Rose St., Berkeley, California 94709, U.S.A. Tel: 010-1-510-843-8416.



This is the Ajax bench milling machine mentioned at the head of this column.

FOR SALE

Very heavy portable grinder (more suited to professional use) £35.
Mr V.V. Tucker, 22 Purdey Court,
The Avenue, Worcester Park, Surrey
KT4 7EN. 081-330 4125.

Precision motor/gearbox units by
Philips/McLennan. Rated at 5.5 LBIN
torque at 20 RPM with 24V applied.
Gearbox has all metal gears with ratio
of 150:1. Output shaft is $\frac{3}{8}$ x $\frac{1}{2}$ in. and is
fitted with 10T brass spur gear of 32DP.

John Rae, Kilncroft, Hillside Crescent,
Langholm DG13 0EE. 03873 80010.
£5.75 each inclusive of postage.

1h.p. electric motor single phase 1425
rpm 240 volt. 50/60 cycles. con. rated
foot mount $\frac{1}{2}$ in. shaft with pulley 13 amp
plug fitted. Money refund guarantee.
£50. Tel: Blackpool 0253 354478.

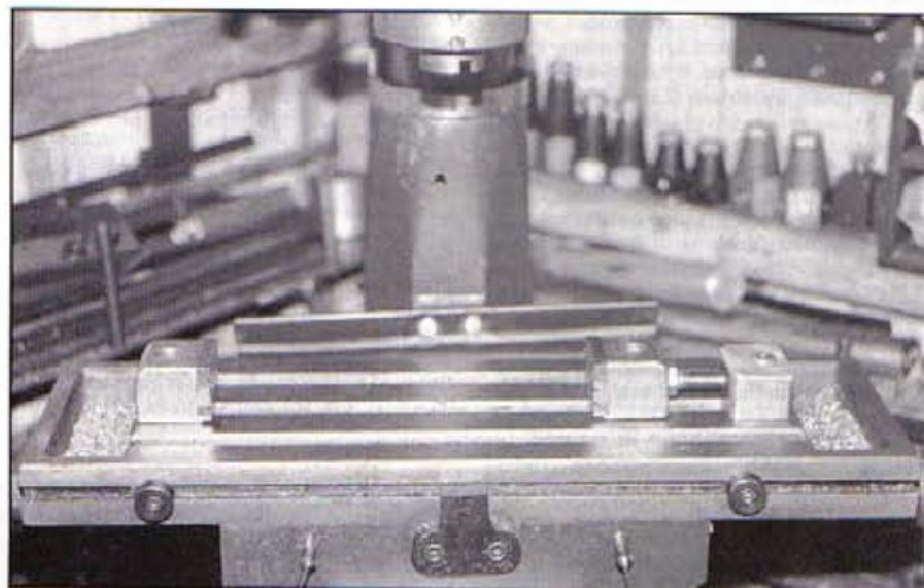
A large barrel Moore & Write
micrometer head, 2 $\frac{1}{2}$ in. barrel diameter
reading in increments of 0.002mm. Not
new, but unused and still boxed. Price
£50, or exchange for miniature 3 jaw
lathe chuck. 2 Holly Road, Poynton,
Cheshire SK12 1PA. 0625 879 521.

Drilling deep holes

A deep hole should not be started with
a 'long series' twist drill. A standard
drill can be used up to its flute length
and then exchanged for a longer one.
The second drill should be no longer
than twice the flute length of the first.
If a deeper hole is required an 'extra
long series' drill should be used which
should be no longer than 3 times the
length of the first and so on.

Alan Jeeves

Large Capacity, Two Part Vice



1: Showing how the capacity of the vice is almost the length of the machine table.

The vice which is supplied with many of the mill/drills, which have now become very popular, may be found to be too small for many jobs in the home workshop where, perhaps, a large casting, for example, has to be face milled completely and clamping on top is unsuitable. These particular vices, like many others which are to be had for use on small machines, usually have a maximum opening width of around 70mm. If a larger vice is obtained with a greater opening width than 70mm it will probably be realised that it may well be too large to be comfortably mounted onto the milling table.

I have for my machine, a Nu-Tool MD350, a set of vice heads which clamp directly onto the table, which can be adjusted to suit the width of the workpiece, and are contracted – by means of a simple jacking screw – to retain work sufficiently

securely to carry out the necessary milling work. The great feature of this contrivance is that the maximum width of the jaw opening is very much enlarged when compared against the standard vice, being restricted only by the length of the table to which it is fitted. The general assembly drawing gives an indication of the useful capacity of this vice and the distance between the inside faces of the two jaws (item 2) exceeds 250mm on the MD350 for which this one was made.

A look at the sketch of item 1 discloses that the vice heads consist of a block of metal which is stepped to accept the jaws (item 2). This step advocates rigidity for the jaws when they are screwed into place.

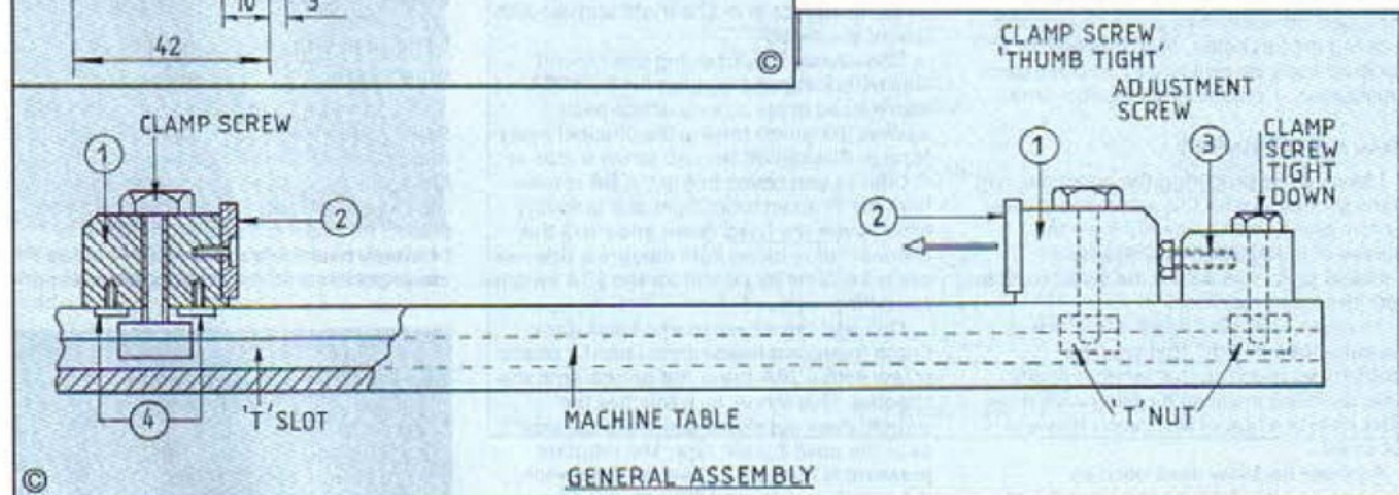
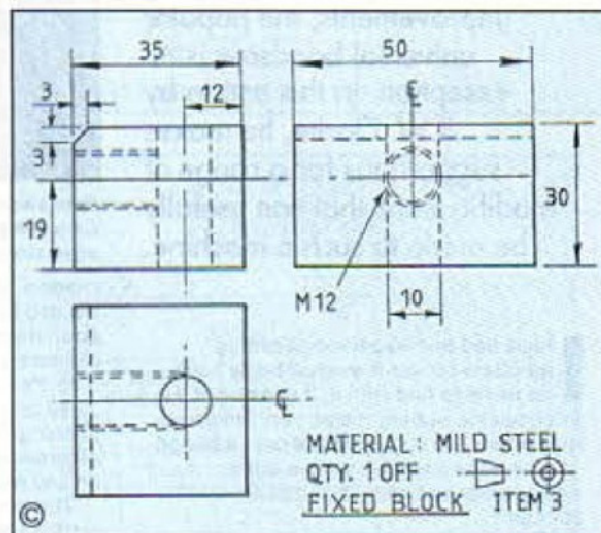
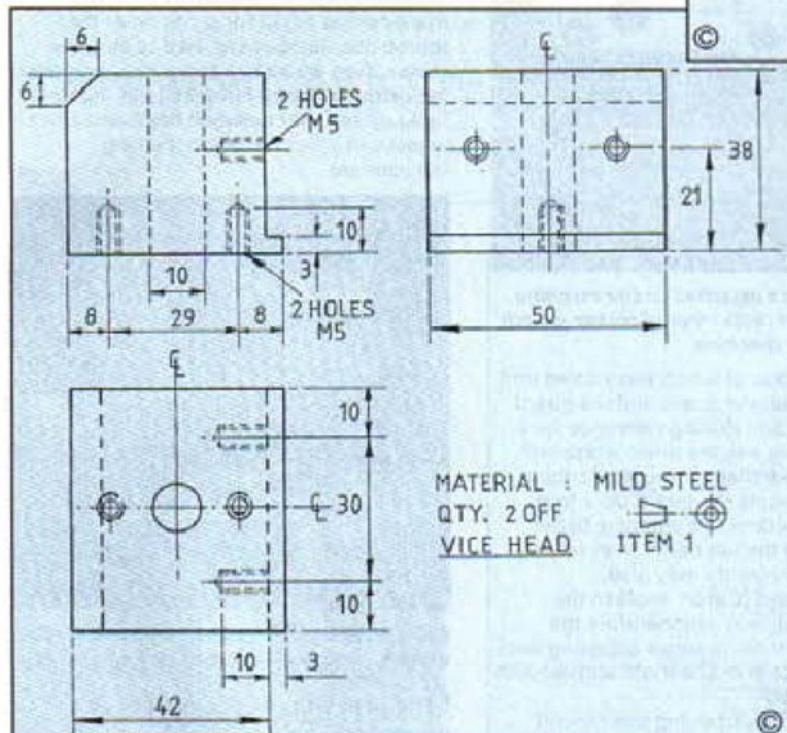
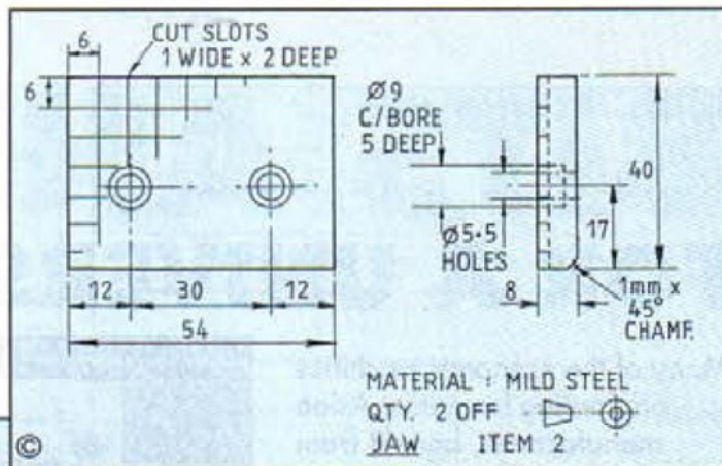
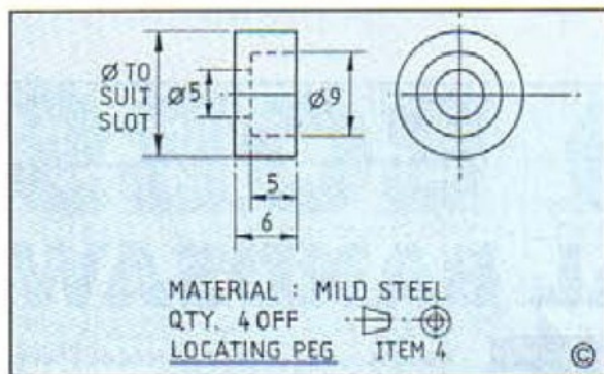
If you require such a vice as is being described you must have a milling machine on which to use it, therefore the machining of components should not be a problem.

A large milling vice will be heavy to fit, expensive to buy, and still probably have a maximum capacity of around 100mm. This two part vice, from Alan Jeeves, overcomes all these limitations.

Dimensions can be altered to suit individual requirements. The 6mm x 6mm chamfer on item 1 allows better access for the spanner to the adjusting screw as can be seen on the general assembly drawing. Only one head then, requires the chamfer but I have machined them both in the interests of uniformity. The pair of M5 tapped holes on the under side of the heads should be positioned accurately on the centre line. The tapped holes are there to screw the locating pegs (item 4) into. These pegs are turned up on the lathe to precisely fit the "T"-slots of the machine table and are important for ensuring that the jaws are square with the table each time the vice is used. A step has already been machined in the vice heads and, following the fitting of the locating pegs, the heads can be clamped to the milling table and faced true with an end mill whilst they are fixed in place.

The jaws (item 2) can be made to suit the individual preference of the craftsman. They can be mild steel "soft jaws" or hardened and tempered "hard jaws", plain surfaced or 'cross hatched' (with a hack saw) – even alternative sets can be provided (brass, plastic etc).

The fixed block (item 3) is simply a secure means of work support. It clamps to the table and the head of the adjusting screw (which is faced flat) bears against one of the vice heads. There is no need to furnish the fixed block with location pegs



unless you wish to do so.

In use the first vice head is clamped to the machine table by means of a "T"-nut and is tightened down firmly with a clamp stud (mine are 1/4in. UNC). The location pegs, as we have seen, guarantee squareness with the axis of the machine. The second vice head is placed at approximately the required centres and is clamped to the table with a second "T" nut but on this occasion it is not tightened down as firmly but is lightly held so that the head can slide along the "T"-slot, as it is jacked by the adjusting screw, until it firmly clamps the workpiece. Clearly the heads can be set to any centres and can hold any width of job from 0 to (in my case) 250mm, a very worthwhile accessory to have for the milling machine.



2: The two jaws. The one upside down shows the pegs which locate in the table tee slots.

BITS AND BOBS FOR A UNIVERSAL BANDSAW

Many of the economy machines originating from east Asian manufactures, benefit from some additions and minor improvements, the popular universal bandsaw is no exception. In this article by R.W. Clarke, he makes suggestions for a range of modifications that can usefully be made to such a machine.

I have had my Warco metal cutting bandsaw for some years. I really have no faults to find with it, it does what it is intended for, cutting metal, very efficiently; only when one comes to use over a period of time does one wish certain other refinements had been included as standard ...

Whether these additional items could be construed as just 'gizmo's' gimmicks is shrugged off when they prove their worth in doing the job better, and thus adding to the machine's versatility and ones personal satisfaction ... plus saving valuable time?

New on-off switch

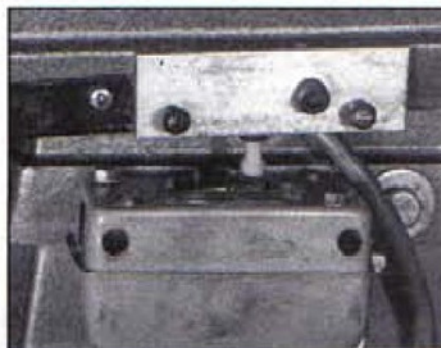
I have, since procuring the bandsaw, had many problems with the automatic 'push-button' on/off switch, mainly from the ingress of metal dust, which caused electrical problems within the switch casing from the switch contacts.

To reach "on" was no problem, it was the automatic to "off" that was the problem, so much so that when it finally blew-up filling the switch casing with more parts than in a box of Meccano I threw in the towel.

A power hacksaw does need an automatic switch? After many months of making do by switching from a power point I decided to make a further attempt to make it work only this time I committed the switch casing contents to the dustbin. I searched through my catalogues and decided on the Tandy 16 amp Rocker Switch No. 275-7056.

The existing hole left by the twin push buttons being too large I turned the casing over: and after refixing with Allen cap screws to its original position in the tapped holes, I then cut a slot in the centre of the new top face to take the switch, thus allowing the plastic type springs to secure it into this slot.

To cancel the original push-switch a small plastic covered piece of angle was affixed by a single screw to the Saw Blade Guard: the back of this guard has a full length access door. After discarding this piece of angle I tried a piece of 1in. alloy



Saw switch box attached to the machine. Cancelling bolt rests clear of rocker switch after stopping machine.

channel one edge of which just slotted into the gap between the guard and the guard door: marking and drilling clearance for a cap screw fixing into the angle's tapped hole. Part of this channel requires cutting away as it prevents the guard door from opening. The size of this cutout is better ascertained on the job rather than relying on any measurement I may give.

The saw guard is at an angle to the cutting table surface and therefore the channel so far fixed requires adjusting until its lin. front face is in line (right angles) with that of the switch.

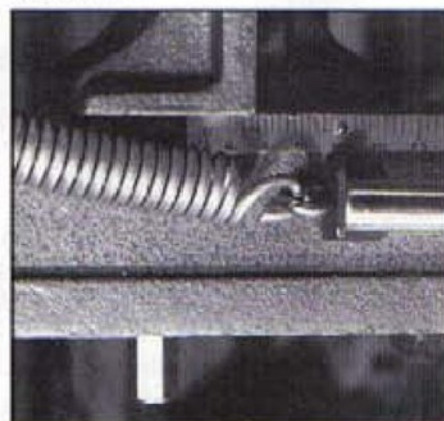
The easiest way of doing this I found was by drilling and tapping for 2 off 2BA round head brass screws which push against the guard forcing the channel away from it. Slacken off the cap screw a little at a time as you screw home the BA screws until the channel looks right and is solidly firm. Lower the head down and mark the channel (alloy being light coloured, this can easily be done by pencil) for the 2BA switch cancelling screw.

Drill and tap where marked and screw home the round head screw I used a plastic screw with a 2BA brass nut to lock onto the channel. This screw, as it touches the switch, does not cause any electrical arcing as in the push-button type; the moment pressure is brought to bear on the switch, the switch springs to OFF and stops the machine.

The two halves of the switch casing are joined together by a small brass knurled thumb screw; behind this screw I fixed the electrical earth, after soldering it into a wire solder ring. Likewise the power line to the switch tongue contacts should be soldered or pinched together into push-on bayonet type holder which are safely hidden within the switch casing.

On later models the position of the switch has been changed to the rear end below the motor; this I should imagine requires one to stretch a little to reach ... with the switch in the position shown on my machine (as fitted when purchased) the guard may be held by its handle and the blade just hovering above the material to be cut. With the new rocker switch this allows one to lightly slide a thumb over the switch to rock it to ON; should the blade

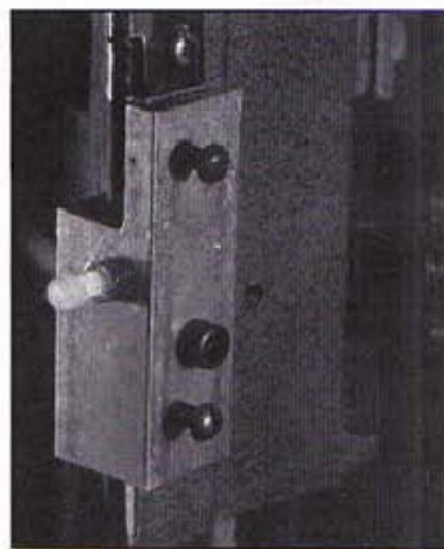
decide to come off the drive wheels (I have been confronted with this dilemma on several occasions, especially after the machine has stood for some time) the thumb may be likewise used to stop the motor. Two wheel bandsaws can be most 'adjustment' temperamental; the slightest build up of swarf between blade and drive wheel will affect the blade tracking (adjustment).



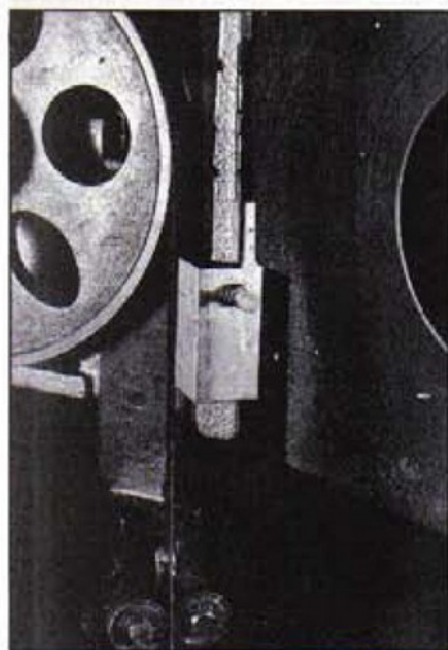
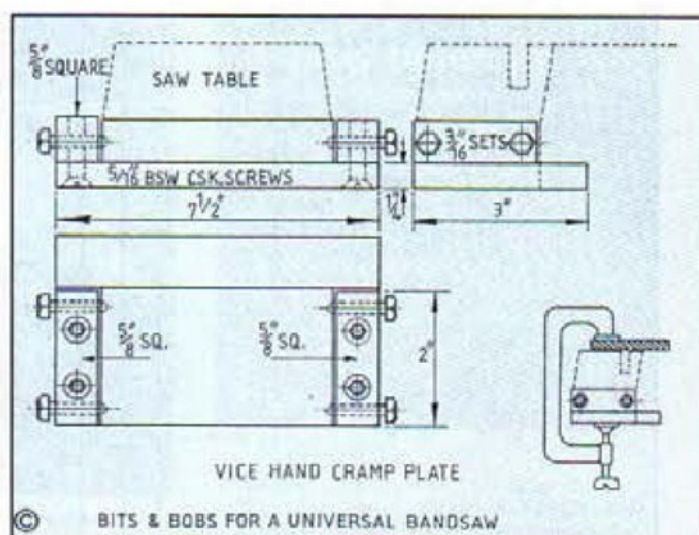
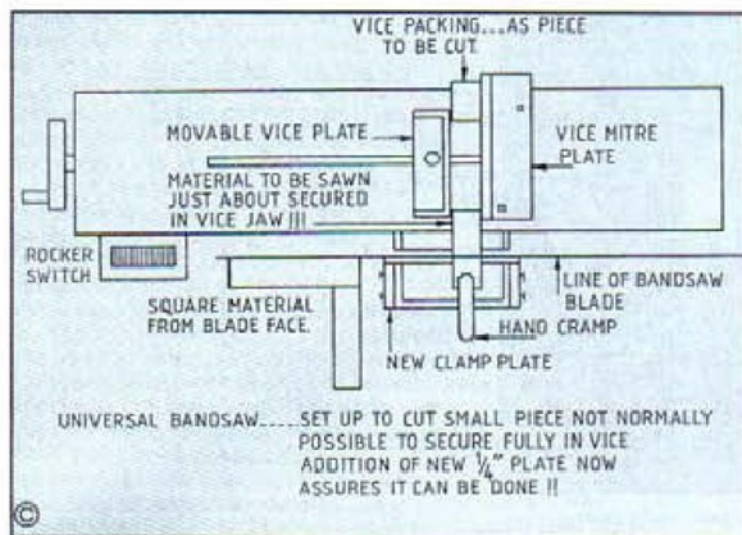
Mitre vice plate bolt projects well below table casting, no fumbling or looking for to locate.

Movable vice jaw: mitring vice plate

The securing bolt in the saw's vice plate had become badly worn; this I replaced with a "skyscraper bolt" made from 1/2in. hexagon bar; at the same time as making a matching pair for the mitre vice plate: the reason for making a special long 'nut or bolt' was twofold, that they would allow easier access and not obstruct the spanner



Alloy channel attached to machine guard showing cut out for the guard door. With its single securing cap screw and the two 2BA alignment screws. Centre adjustable plastic switch cancelling bolt secured to channel by a 2BA brass nut



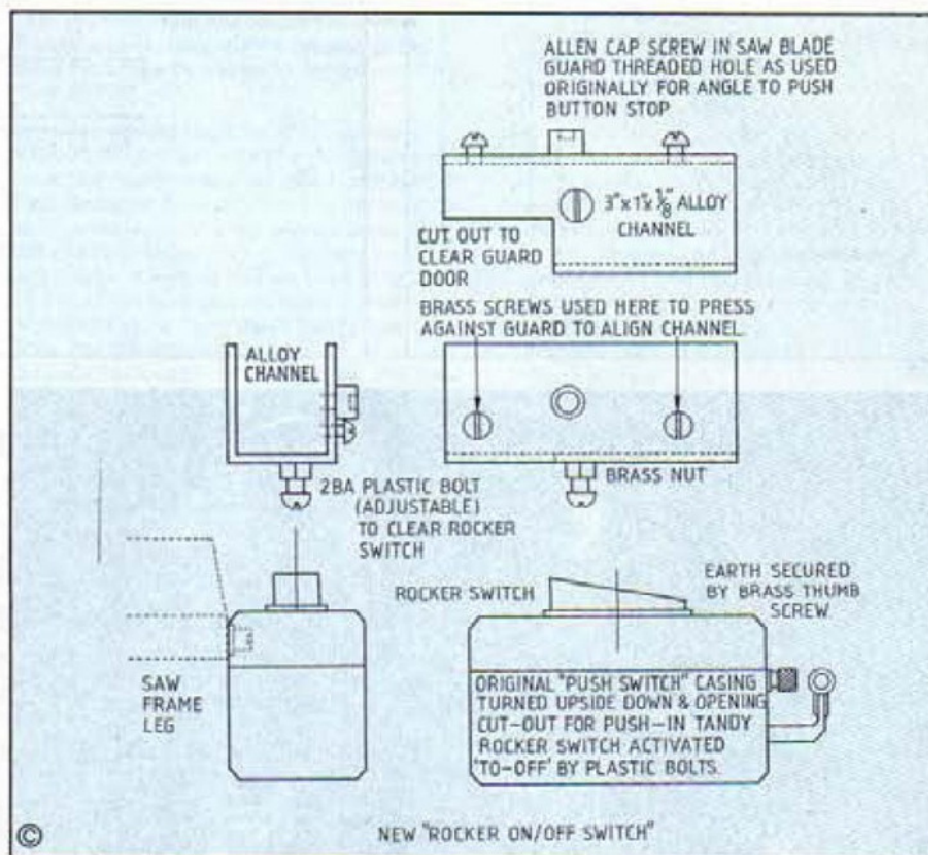
Alloy channel attached to the machine guard showing clearance cut out for opening guard door.

on the vice plate casting: for the underside of the mitre vice plate, and that its projection below the casting line of the table would make it much easier to carry out adjustments. I found it easy to do this, just by simply sliding the spanner along the underside of the table edge until it touches the projecting bolt. Once it is within the spanner the top one may be held fully in the fist: a quick flick of the wrist and the nut is loose, all without looking ...!!

Three 1/2in. bore washers 1x1/2in. are required: these may have to have a little filed off one edge to clear the relative casting: the hex bar is shouldered accordingly. No further explanation other than to state that they have proved far better just one spanner size and I don't have to get on my knees fumbling under the table casting trying to tighten a nut ...! Similar bandsaws especially late models may have metric threads as standard, it would be wise to check.

'G' cramp clamping plate

Securing material over 3in. long within the table's vice jaw is OK, smaller lengths can be where one has a problem,



especially where the piece is 'all but' projecting beyond the reach of the vice jaw: handy when a piece would be better sawn than parted off in the lathe, or laboriously hacksawn. There is a projecting table like section at right angles to the main table, this is a hollow casing which does not allow any hand 'G' cramps to be used. Therefore the small piece of 1/4in. plate was made as detailed in the drawings and secured beneath this projection by four 1/4in. setscrews pressing against the table casting's edge through a 1/4in. square piece of BMS. This new surface affords a flat face for the hand cramp screw to bear against: these two 1/4in. square pieces are secured to the 1/4in. plate by csk 1/4in. BSW screws.

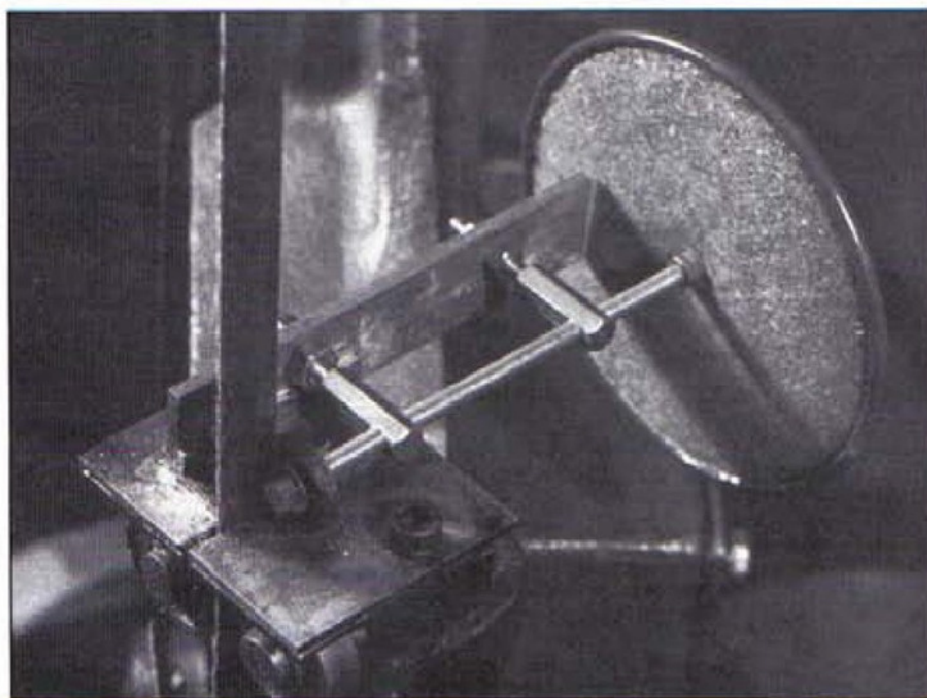
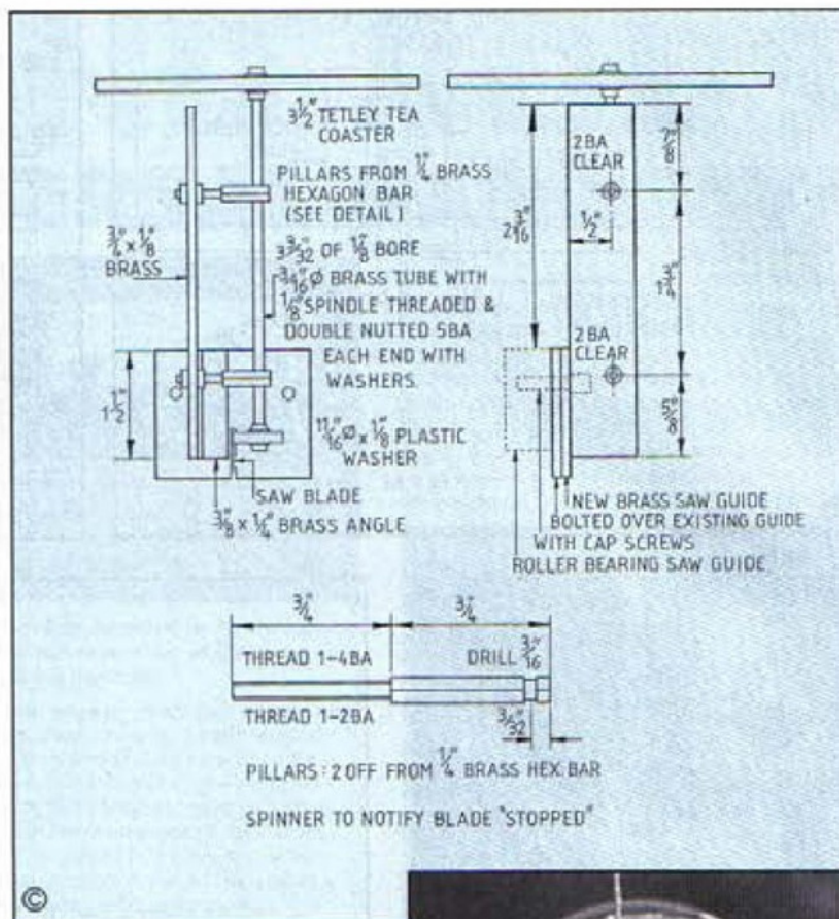
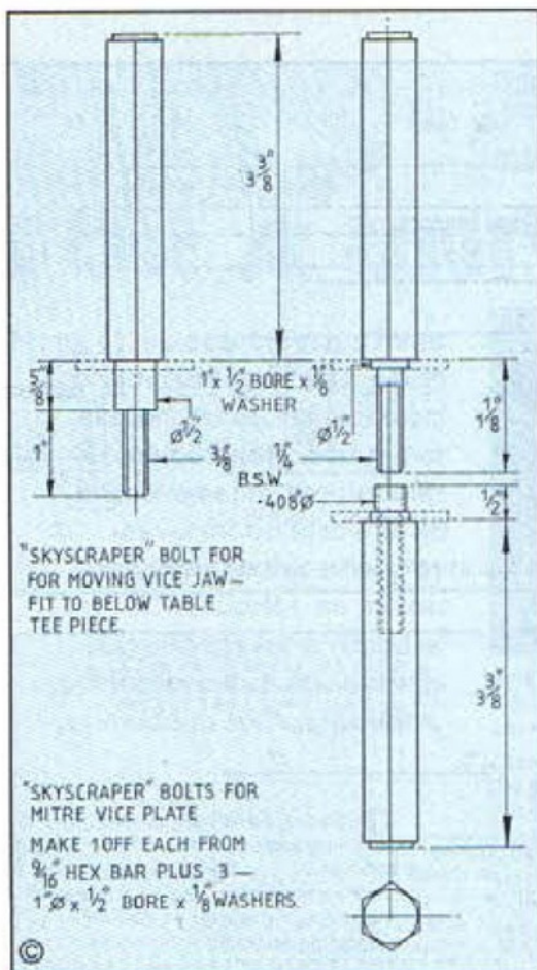
As the bandsaw affords a sliding motion through the material not a 'push-pull' one, as in reciprocal types of saw, not a great deal of 'cramp' pressure is required to

Recycling reamers

If you have a tool and cutter grinder you can re-grind worn or damaged reamers to produce the next size down, e.g. 1/4in. can make 6mm.

Alan Jeeves

secure small pieces. This is more a test of one's ingenuity; pieces with a flat face pose no problems: rounds may be held within a small engineer's (home made) cramps; larger diameters may be double cramped and a small plate placed on top, these then 'G' cramped to the table at times this 'G' cramp may have to have a large throat ...! As long as the final set-up in no way fouls the blade then it can be sawn ...?



Blade spinner secured to blade guide by Allen cap screws, saw guard in vertical position

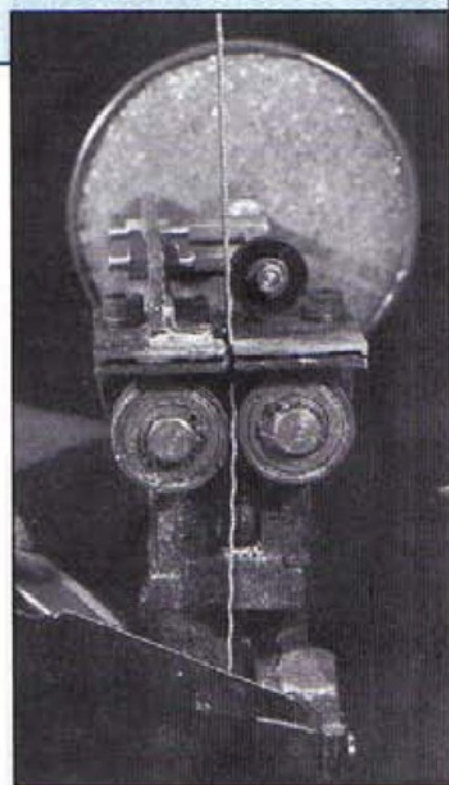
Indicator for blade jammed or stopped

This really is a "Gizmo" - a genuine gimmick - but it does indicate that the blade has jammed in the cut; the machine motor continues to work with the blade sliding over the pulley. Whether it be intermittent use or failing to check blade adjustment before using, my machine does tend to quickly loose its initial settings. Then the slightest twist (out of vertical) of

the blade makes it more than happy to jam in the cut. Continually changing the motor belt and speeds is quite onerous when one can handle a variety of materials the cutting of which takes but a few 'moments' spread over many workshop visits.

This is most annoying as the power hacksaw is about the only machine that one can leave with any confidence to switch itself off on completing the cut.

Although the motor or 'noise tone' changes when this jamming has taken



Saw blade spinner with its hard plastic (water tap type) washer just touching the blade. 1/4 inch hexagon pillars have sufficient adjustment left in the threads for a model car wheel or purpose made rubber one.

place one can only hear this when no other 'noise' is present.

From experience of using this machine I have found that holding on to the guard handle is advisable until the blade is well clear of the teeth depth within the cut before letting go, thus allowing the machines spring downward pressure to take over to completion.

My saw is about 8ft. from my lathe and the many times I have had the saw going whilst I am busy 'turning' I find that the occasional eye squinting trying to see if the blade is still operational not all that good, sometimes for my neck, less frequently for the work in the lathe. My lathe is centrally situated, surrounded by benches. I had thought many times how much easier I would be able to see a coloured spinner.

Continually tightening the blade tension handle shortens blade life. (From experience only taking out any slackness present.) Over many years I have perfected the art of 'supping tea' the Tetley Tea Company bless them supply 240 bags to the box and throw the odd free gift in with the nourishment; recently this has been in the form of several tea cup coasters depicting the jolly little chaps one sees in their telly adverts: these coasters are in various colours and 3 1/2 in. in diameter.

I had put out the workshop lights and retired for the night just made a 'cuppa' which I was about to lower down onto a coaster when I had a flash of inspiration ... 'me spinner ...!!

Still holding my cuppa and the coaster the workshop lights were brought back to life and my 'filing cabinet' metal store rummaged through to see what would be suitable; my only concern really was that the spinner would have to be well clear of the machine's guard.

I made all the parts from brass leaving the soldering to the following day when I used builders solder with Powerflux the flux that does away with cleaning the material. I first tinned all parts where they



Tetley coaster removed from its spindle resting on the saw table. The end of a short length of 1/4 inch round just about held in the vice, the projecting end secured in a small hand clamp which in turn is secured to the table projection by a large 'G' clamp.

would be joined together: this method allows the spinner unit to be disconnected from the machine with as little disruption as possible and the original countersunk screws replacing the cap screws (assuming they are put safely away). The 1/4 in. bore brass tube is 3/4 in. O.D. Two 1 1/4 in. lengths of 1/4 in. brass hexagon bar were drilled 1/4 in. from their ends 1/4 in.; these two pieces form the adjustable pillars, one of which is threaded to a depth of 3/4 in. for 2BA and the

Plastic beading

The other day I required some plastic beading to use on the edges of a metal box, and came up with the following idea. Take some scrap electrical flex of suitable length, cut along side and remove inner wire. This can then be stuck in position using a suitable adhesive. It can also be used as grommets on round or any odd shaped hole. One advantage is that it can be made any length, and if made from scrap cable it also costs nothing!

G.R. Barker

other 3/4 in. deep for 4BA, this latter thread allows some lateral movement in the 2BA clearance holes drilled in the flat brass 1/4 x 1/4 in. upright.

I have not soldered the brass tube to the pillars, as I intend using a much softer wheel when one becomes available, depending on this acquisition will depend the repositioning of the tube. Allow a little play at each end of the 1/4 in. spindle that secures the coaster by two 5BA nuts and the 1/4 in. plastic hard washer which I have found only just needs to lightly touch the blade to start the coaster spinning ... a little play prevents the end nuts unscrewing themselves.

In no way can this spinner cause injury as it slowly rotates.

A feather would stop it ...!
"ain't it great".



IN OUR NEXT ISSUE!

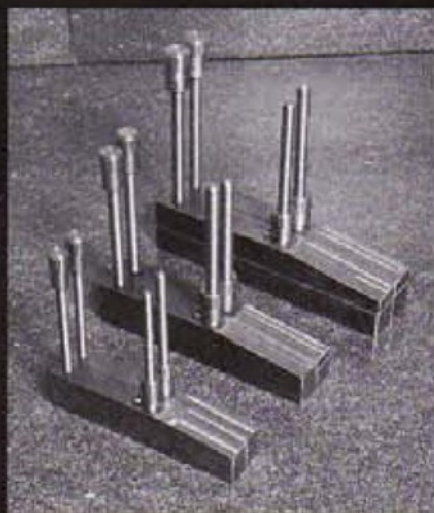
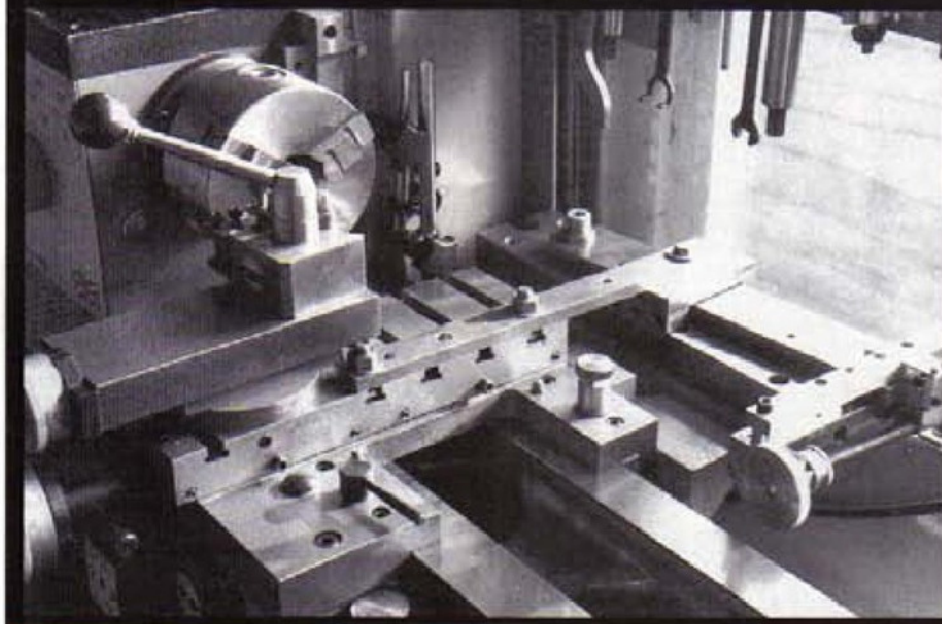
Coming up in the SEPTEMBER/OCTOBER issue No. 25 will be:

Toolmakers clamps of non traditional design, the first items from John Steele's new workshop.

A device for the accurate setting out of angles.

A taper turning attachment for a larger lathe.

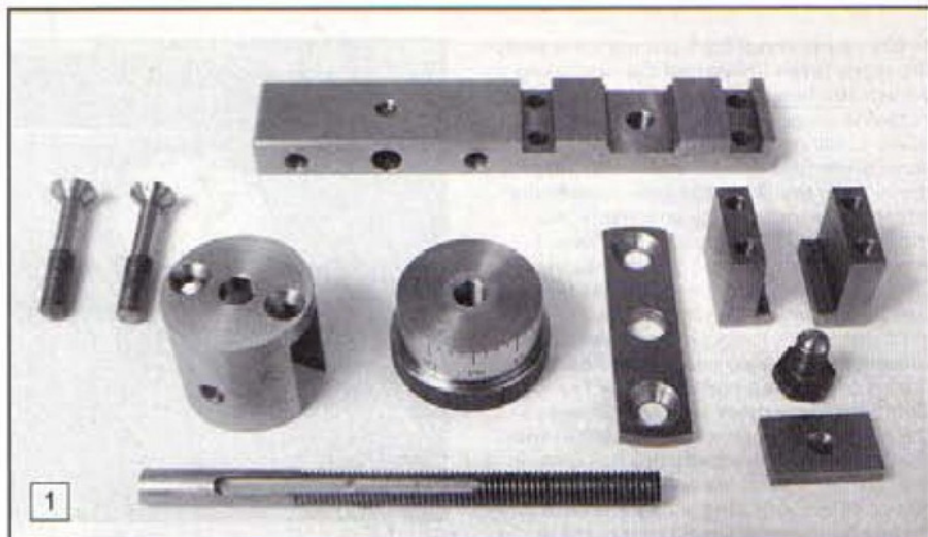
Contents may be changed



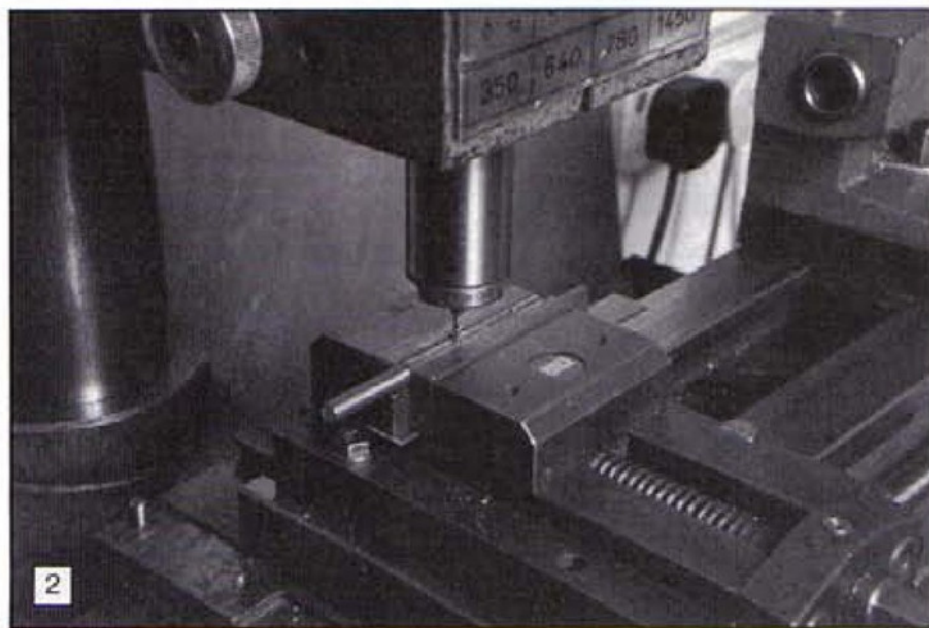
**AND MUCH MORE
Issue on sale
11 August 1994**

In this article Peter McQueen provides the design for a saddle stop for the Emcomat-7 lathe. It has a calibrated stop so will be particularly helpful in producing accurate work. This design will be very easy to modify to suit other lathes.

Soon after acquiring a 25-year-old Emcomat-7 screwcutting lathe (3½in. centre height) I decided that a very useful accessory would be a graduated saddle stop. As a device of this type was not available from Emco-Maier I set about designing and building my own. Although the saddle stop described here was made specifically for the Emcomat (which has no bed gap) it should be possible, with only minor modifications, to adapt it for any other lathe of similar size which has flat bedways. I have found it to be an invaluable aid when boring to a precise depth and when turning up to a shoulder.



GRADUATED SADDLE STOP



machined parts before assembly (sharp-eyed readers will notice that the modified set screw is missing from the photograph). The M5 countersunk screws which hold the retaining strip are shown with the top part of the thread machined away. This is not strictly necessary and was only done to give the finished device a more professional look.

The spacing of the mounting claws depends upon the width of the front bedway (35.25mm in my case) and needs to be accurately maintained. Similarly the depth of each claw is related to the thickness of the bed edge but this dimension is not quite so critical. The rear claw is assembled using countersunk M4 screws, thus providing maximum clearance under the lathe chuck.

The spindle is made from 6mm diameter precision ground silver steel. In order to obtain maximum accuracy, the spindle thread must initially be cut in the lathe. The thread form is then finished off using a split die which has been opened to its maximum extent. The spindle thread is offered up to the tapped hole in the thumbwheel and if the fit is too tight then the die should be set to a slightly smaller diameter and run down the thread again. This process is repeated until a good fit is obtained. It is better to machine the slot in the spindle after the thread has been cut. **Photograph 2** shows the slot being machined using the Emcomat-7 vertical milling attachment. After this operation any burrs on the thread should be carefully removed by hand, using a small three-square file.

With regard to marking the graduations on the thumbwheel, the method which I employed is illustrated in **photograph 3** (again using the milling attachment on the Emcomat). The thumbwheel is held in the chuck of a vertically mounted rotary table immediately below the milling spindle. The milling chuck, which is not rotated, is fitted with a broken centre drill that has been

Design

The saddle stop requires no modification of any kind to the lathe; it is attached to the front bedway and is free to move longitudinally. In use the stop must be clamped in a convenient position and a gib strip is incorporated to prevent damage to the lathe bed. Saddle movement towards the headstock is stopped by the end of the spindle. Accurate adjustment of the spindle position is accomplished by rotating the graduated thumbwheel.

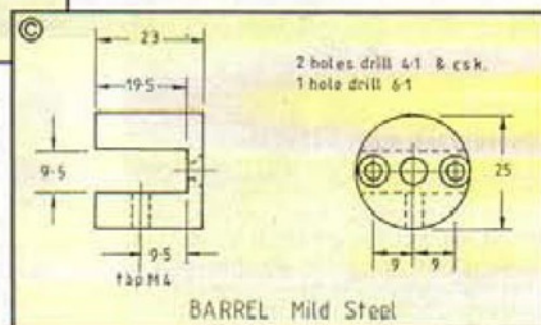
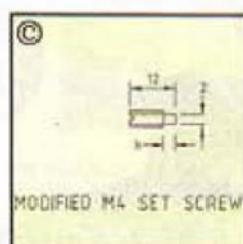
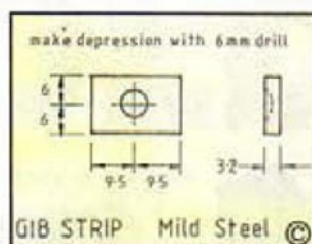
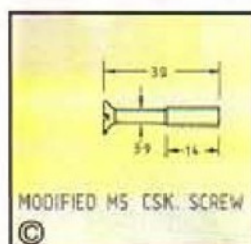
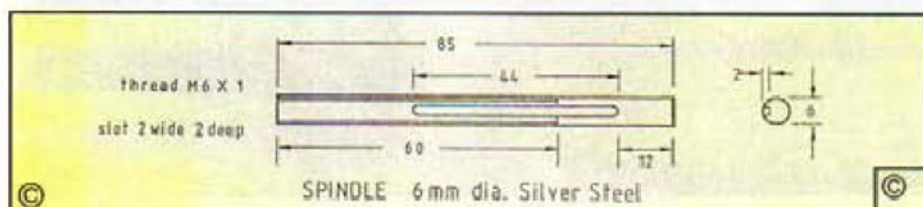
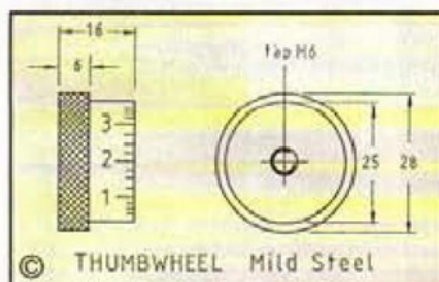
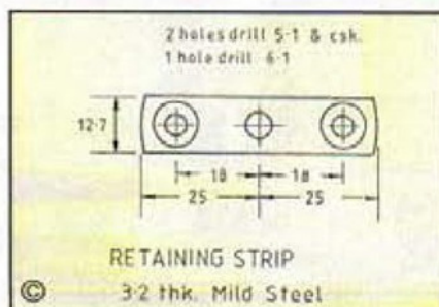
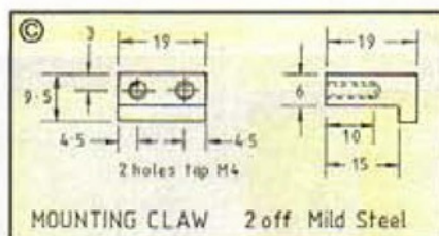
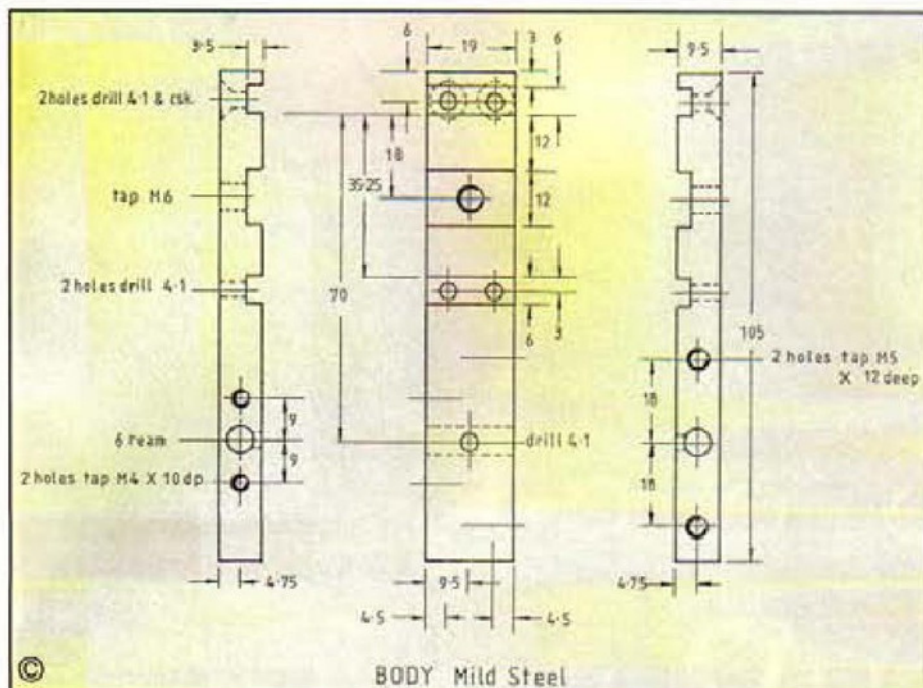
Since the Emcomat is a metric machine I decided to execute the design in metric units, even though most of the material used is of Imperial dimensions. The device needs to be as compact as possible in order to minimise both the reduction in swing over the bed and the restriction of saddle movement at the headstock. Rectangular bar ¾ x ¾in. is used for the body. A spindle diameter of 6mm has been

chosen so that the standard 1mm coarse thread pitch can be used for the spindle and thumbwheel. The thumbwheel is graduated with 40 divisions giving a resolution of 0.025mm or approximately 0.001in., which is the same as the graduations on the lathe handwheels. With a barrel diameter of 25mm the graduations are about 2mm apart which makes them very easy to read. The linear range of spindle adjustment is about 40mm but this may be altered to suit individual preference.

Mild steel is used for all parts except for the spindle which is silver steel so that it can be easily hardened.

Construction

Construction is quite straightforward and only a few practical points need to be mentioned. **Photograph 1** shows the



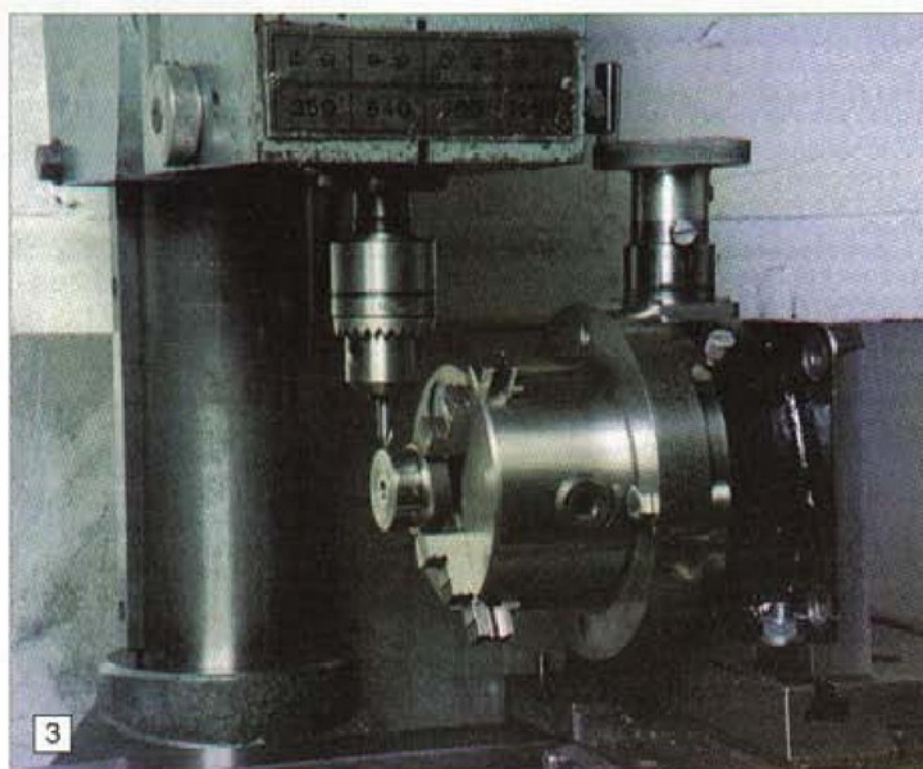
ground to a sharp point. For each graduation the saddle is moved so that the point scribes a line on the periphery of the thumbwheel. Major graduations occur every 36 degrees with the intermediate lines scribed at 9 degree intervals. This is a good example of the type of operation which would benefit from the use of the completed saddle stop! The major divisions are then marked from 0 to 9 with a number punch as shown on the drawing. In addition, an index line is required on top of the barrel.

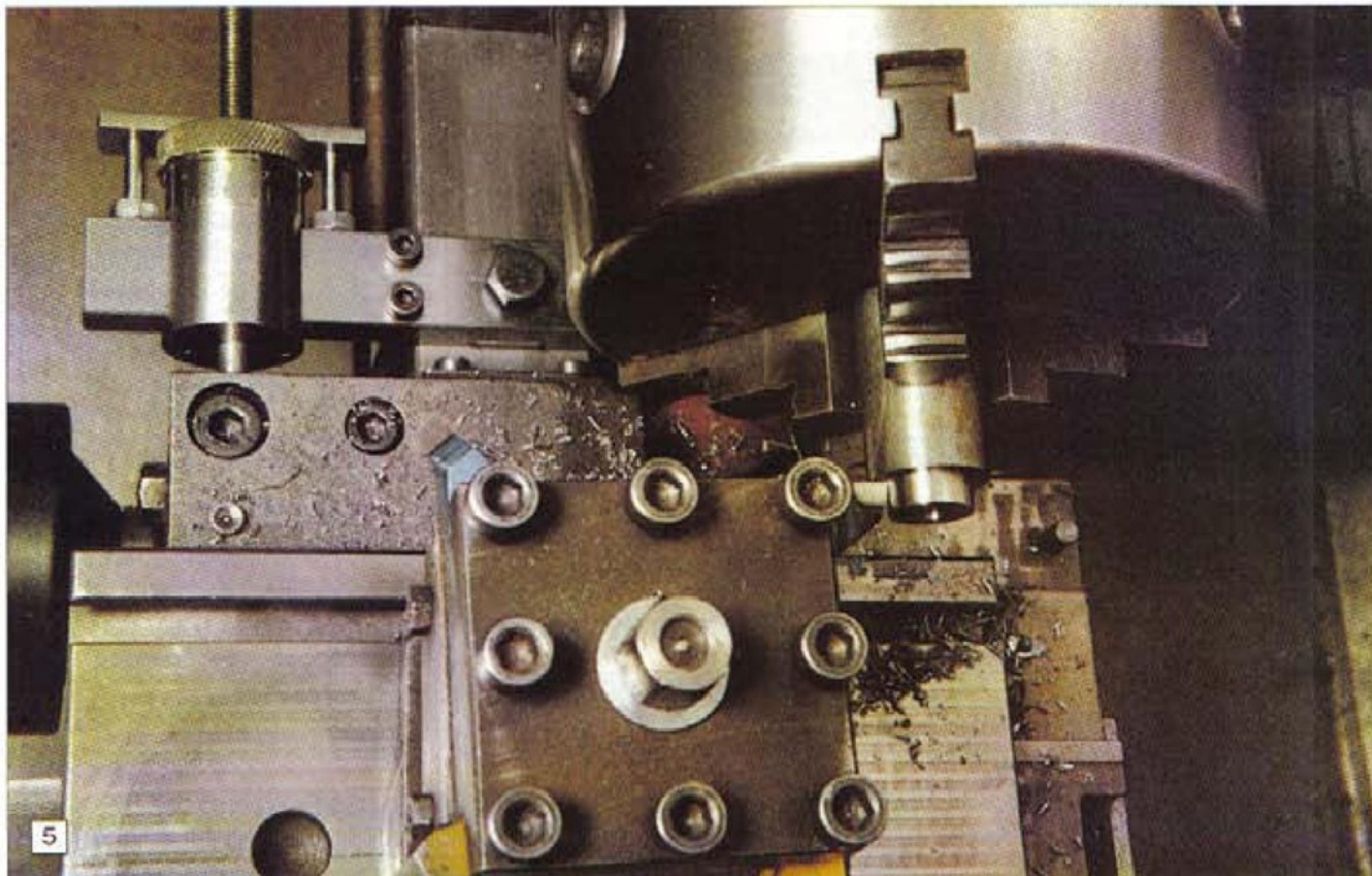
Reaming allowance

A common fault when reaming is to leave too little material in the hole for the reamer to cut at its best. It then ends up rubbing and wears very rapidly. The following approximate allowances left in drilled holes for reaming will give good results.

- Up to 10mm leave 0.3mm
- 10 to 14mm leave 0.4mm
- 14 to 30mm leave 0.5mm.

Alan Jeeves





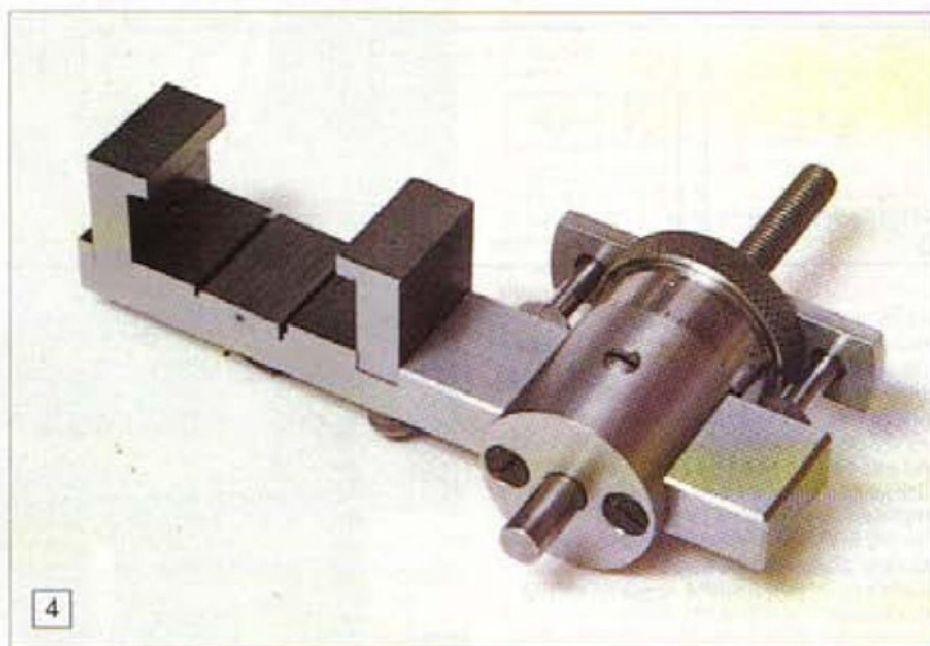
Assembly

Photograph 4 shows the assembled unit upside down with the gib strip and set screw in place. The set screw must be adjusted to prevent rotation of the spindle while allowing free longitudinal movement. After adjustment the set screw should be sealed with a drop or two of Loctite 221 Screwlock compound. Care should also be taken to adjust the retaining strip, using the M5 countersunk screws and locknuts, so that the thumbwheel rotates freely but with no end play.

A shortened M6 hexagon-head bolt with the end rounded off is required as a clamping bolt; this engages the depression in the gib strip.

In use

Photograph 5 shows the saddle stop being used to turn an accurate length up to a shoulder. It is unlikely that readers require instructions on how to use a saddle stop. However, as the device itself does not have any provision for zeroing the thumbwheel scale, I include a short explanation of how to get around this problem. With the saddle stop clamped and the spindle extended, the thumbwheel is set to zero. The saddle is then moved against the stop and clamped. Facing of the workpiece can now take place using the topside to feed the tool. The spindle is then moved back by the desired amount using the thumbwheel and, after unclamping the saddle, turning or boring may now proceed. It can be a bit tedious keeping track of the number of complete rotations of the thumbwheel, however, a quick check with a ruler before turning or boring begins will satisfy you that no mistake has been made.



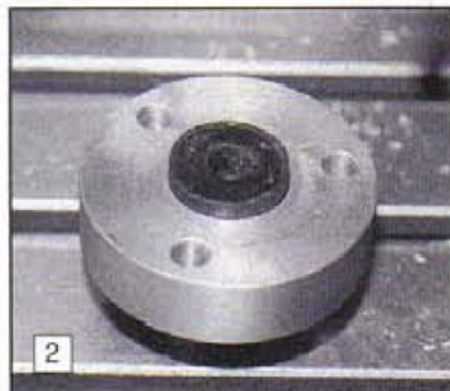
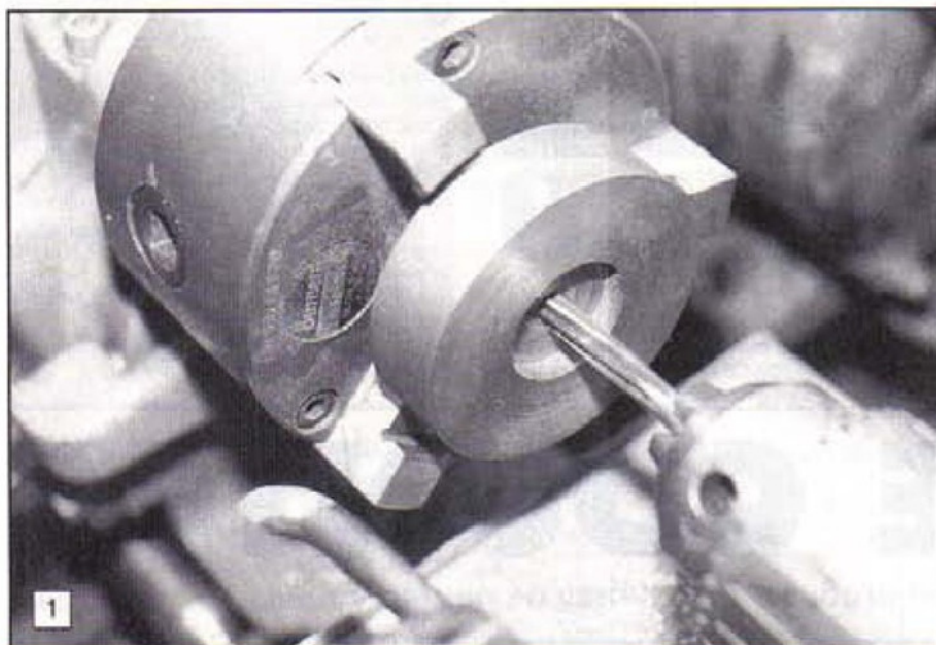
Care must be taken to prevent swarf from becoming trapped between the end of the spindle and the saddle. Finally, a reminder that if power feed is to be used then this must be disengaged at least $\frac{1}{16}$ in. before the saddle meets the stop and the remainder of the cut fed by hand, otherwise your new saddle stop (and possibly your lathe) may be damaged beyond repair!

A word about accuracy

The *resolution* of the device is 0.025mm by virtue of the 1mm thread pitch and 40 divisions on the thumbwheel. The *accuracy*

may well be worse than this and is governed by various factors such as:
 i) longitudinal play of thumbwheel
 ii) rotational play of spindle
 iii) accuracy of spindle thread
 iv) accuracy of thumbwheel graduations
 v) fit of spindle thread in thumbwheel
 vi) parallelism of spindle and bedway.

Some of these factors constitute backlash but the effect of this is minimised because the force on the spindle from the saddle is always in the same direction. With careful machining and assembly it is possible for this graduated saddle stop to have an accuracy which is similar to, or better than, the resolution.



THROW AWAY CUTTER HOLDER

Derek Walters offers a design for a throw away cutter holder for the Hobbymat BFE65 drill/mill, it will also suit the nose of the MD65 lathe.

It is very tempting, especially for the first time owner of a drill/mill, of any make, to endeavour to make do with the drill chuck for holding milling cutters. For the smaller sizes, and with a good chuck and

light cuts, the operator of the machine may get away with this for a while. But some unguarded moment is bound to occur, when the chuck will not be fully tightened and/or the cut set rather heavy, and a project will be spoilt due to the cutter working out.

While a milling cutter chuck is expensive and it is understandable why someone will attempt to do without one, a simple cutter holder of the type proposed here will cost very little and is easy to make, so why not give it a try. I have made it for my Hobbymat BFE65 drill/mill but the principle

could be adopted for any type of machine.

Method

Chuck a piece of continuous cast iron, 65mm dia. x 40mm. long to clean up to 37mm long, in outside jaws, set to run true by chalk and face over end, and on the outer diameter back to the chuck jaws, reverse and do same again.

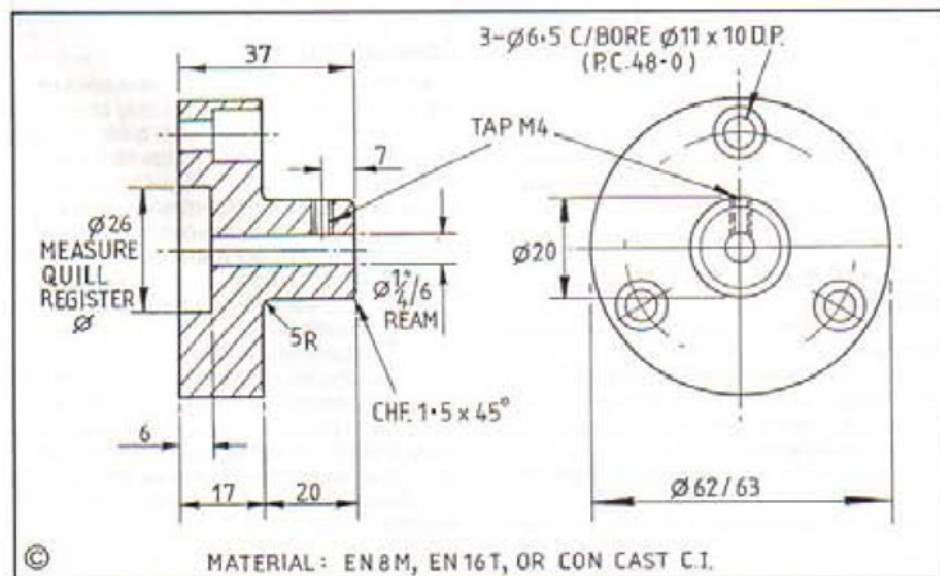
Bore recess for mill spigot register, measure your own mill register which will be about 26mm dia. (1.0236in.) x 6mm deep as drawing. Next centre drill B.S. 3, follow with a stub drill $\frac{1}{8}$ in. dia. for 1in. deep and follow through with a standard $\frac{1}{8}$ in. drill, finish with a $\frac{1}{16}$ in. dia. reamer. This is for $\frac{1}{16}$ in. dia. cutters.

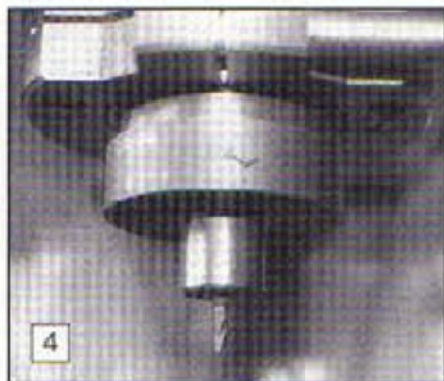
I suggest drilling 5.5mm and reamer 6.00mm for 6mm cutters.

See **photo 1**. Reverse in chuck and turn down nose to 20mm dia. x 20mm long.

Mark off cutter securing screw hole and centre punch. Drill through 3.80mm for M4, fit a M4 x 6 socket set, screw with an inverted cone end.

Turn a location plug from brass or Tufnol to be 26mm dia. x 15mm long, see **photo 2** to be a tightish fit in the internal register of the Hobbymat chuck and the





adaptor now being made. Put just one spot of Superglue on the chuck face and fit to the cutter holder, allow 10 minutes to set. Then set up on top of your lathe catch plate as shown in **photo 3** and, using the body of the Hobbymat chuck, drill through 3 holes 7.6mm dia., pegging the first as shown using a 7mm dia. drill, take care not to damage the catch plate when breaking through.

Part components with a sharp blow from a copper or lead mallet and dress off any residue with a needle file, counterbore the

three holes as drawing 11mm dia. x 10 deep, reverse and lightly countersink the three holes, chamfer recess 0.5mm x 45 deg., chamfer front and rear of body 1mm x 45 deg. and nose 1.5mm x 45 deg.

Oil all over and wipe with a rag to finish. A finished holder with a 1/16in. dia. cutter in it fitted to the Hobbymat BFE65 is shown in **photo 4**. Holders of similar type can be made for larger cutters or end mills which considerably reduce overhang. T.I.R. (Total indicator reading) should be approx. 0.01in 25mm from holder.



TRADE COUNTER

A first look at products which may be new to you



A completely new Cyanoacrylate (Superglue) System by Tufloc

Following the very warm reception for the revolutionary new Pro-Bond Superglue pen launched recently, the Company have listened to many modellers and have decided to offer a comprehensive range of Industrial grade Cyanoacrylates (superglues) in larger 20gm and 50gm bottles to the model and craft market.

Complementing the superglue pen the Pro-bond bottled range offers the larger user the same Industrial strength Cyanoacrylates in a wide range to satisfy all the requirements of the craft and model market. The products are very easily identified by grade number and colour coded so product selection could not be simpler. The craftsman can now select a cyanoacrylate specifically for his application be it fast, slow, thick or thin etc. The products are now available with a comprehensive range of support products such as debonders and activators to satisfy all the superglue users requirements from one UK manufactured source.

Grades available

Six grades are available as follows.

- 1) Low viscosity. Very fast bonding and wicking for use on rubber, plastics and metals.
- 2) Medium viscosity. General purpose quick setting for use on balsa, rubber and common plastics.
- 3) High viscosity. Slow curing, gap

filling, high impact for use on plastics, wood, metals and rubber.

- 4) Flexible set. Shock resistant, flexible bonding for use on rubber assemblies and electronic parts.
- 5) Low odour. For ease of use and no staining for use on plastic, steel and electronic contacts.
- 6) Slow set. Very high viscosity, slow curing, maximum assembly time for use on plastics, rubber and metals.

Pixel-Plus have been appointed by Tufloc as an exclusive distributor of their products for the model engineering market. The addition of Tufloc to the range of Pixel-Plus products, which includes the popular Black-It, is in line with the companies' aim to be a specialist supplier to the model engineering market.

For more information, call: David Goadby at Pixel-Plus, Tel/Fax 0530 262565 or write to Pixel-Plus, Nailstone, Nuneaton, Warwickshire, CV13 0PZ.

Compressed air in the home workshop

In *On the Editor's Bench* in the last issue, mention was made of the use of compressed air in the home workshop. The latest catalogue from Machine Mart contains a number of new compressors, of particular interest is the "Bronco".

This is a low noise, high output, receiver mounted unit. It provides 7cfm air displacement at 115psi maximum pressure

and has a 6 litre receiver. Powered by a 1.5HP, 240v motor, Bronco features a fully automatic stop/start control and has an air pressure regulator and gauge as standard specification. This unit, weighing 14kg, is compatible with the most popular air tools including spray guns, sanders, grinders and air hacksaws. Bronco retails at £140.95 inclusive of VAT.

Machine Mart operate a network of 39 superstores nationwide, stretching from Plymouth to Edinburgh, and a telephone order hotline. Their new 120 page Spring/Summer 1994 colour catalogue is now available free of charge. Simply call 0602 411200 to obtain your copy.

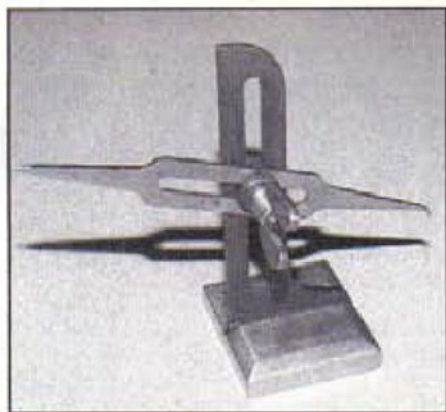


Special offer on books

Frost Auto Restoration Techniques Ltd are making some books available to readers of M.E.W. at a special price. These show savings of from £2 to £3. P&P has also been reduced from £3 to £2 for one order, be it for one or for all four books. The books with their reduced price are as follows. To qualify for discount mention M.E.W.

Metal Fabricators' Handbook	£9.95
Basic Welding	£9.99
How to Cast Small Metal and Rubber Parts	£8.95
Custom Metal Polishing	£8.95

To place order, or for more details, contact Frost Auto Restoration Techniques Ltd., Crawford Street, Rochdale, Lancs. OL16 5NU. Tel. 0706 58619, Fax. 0706 860338.



A SMALL HEIGHT GAUGE

Alan Jeeves provides us with this little project with a useful end product. For those who want to brush up their hand-work, why not, apart from the turned parts, turn off the machines and make this a hand-made item. It looks like a good project for students, any teachers reading this why not give it a try? Also at the end of the project let us know how their students progress with this, or any other project from M.E.W.

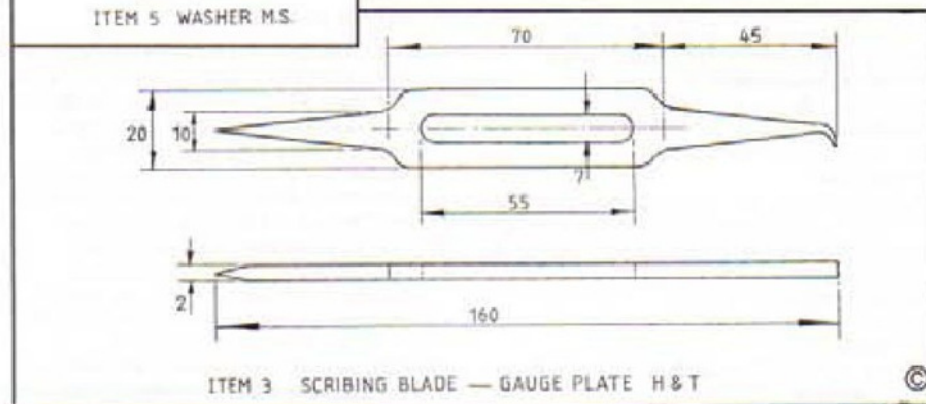
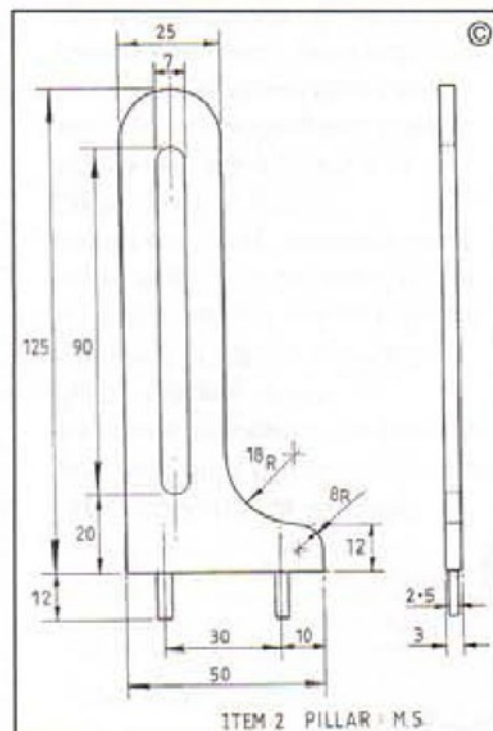
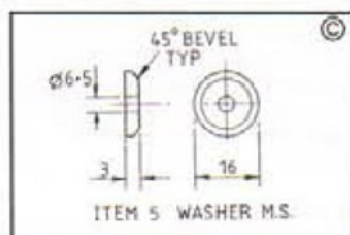
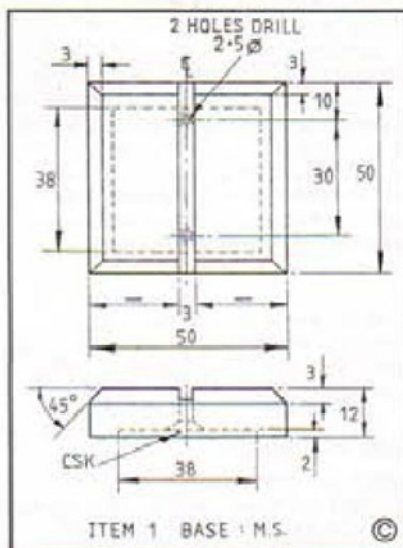
Here is a simple and inexpensive height gauge which is not difficult to make and use. It is very sturdy in construction and will transfer scribed lines accurately. I already own a 300mm precision vernier height gauge but I thought that a smaller, simpler instrument may be useful for general purpose work and so the result was the gadget described here.

The manufacture of the height gauge does not require a great deal of machining, which can all be carried out on a small lathe if needs be, but I have a small milling machine and so utilised it on this job. This project is, however, an excellent exercise in bench work, calling for accurate marking out and filing for much of its construction.

The Base

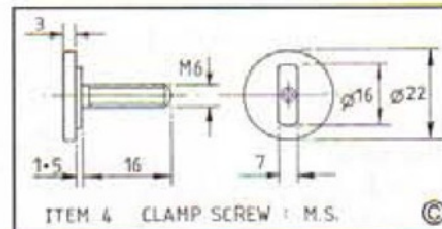
The base (item 1) is simply a mild steel plate 50mm square x 12mm thick which has a slot milled across the centre into which will be mounted the pillar (item 2). The underside of the base must be flat and the centre is relieved, as the pillar is riveted from this side. This relief can be either milled away on the vertical miller or it can be turned away by setting in the 4-jaw chuck and recessing out to 38mm diameter. The two 2.5mm dia. holes (which are countersunk from the bottom) can be accurately drilled or, as an alternative, they can be left until the pillar has been made and then marked off from the location pins on this item. The edges of the base are bevelled all the way round in order to make it pleasant to handle; this feature is optional.

The pillar (item 2) is made from a piece of 2x1/4in. thick strip. By using this section the 1/4in. thickness will have to be reduced slightly to fit the 3mm wide slot in the base.



Of course 3mm thick plate can be used and the slot milled a tight fit also. At the base of the pillar will be seen two location pins. These require accurate cutting out and filing. It is not essential that they are exactly round but they do have to go through a 2.5mm dia. hole. The slot is better milled in before the pillar is profiled as it may be clamped in the miller more easily. When the pillar has been completed it is located into the base and tapped home with a mallet. The whole thing is now turned over and the location pins should be protruding through at the bottom of the base. They can then be peined over to fill the countersinks and, when this is done, the heads should be below the flat plane of the base.

The scribing blade (item 3) is fashioned out of a piece of gauge plate. This again is a cutting out and filing job after the slot has been milled. The scribing points also have to be formed. This item will require hardening and overall heating to cherry red and quenching in oil is the way. It should



not need tempering as it will not be subjected to any heavy blows but it would not be a good idea to drop the gauge at any time in the future.

The clamping screw (item 4) and washer (item 5) are made from mild steel and are turned on the lathe. The location flat on the screw is simply filed on. It must be a sliding fit in the slot in the pillar and when this is achieved the scribing blade is mounted using the washer and a standard M6 wing nut to hold it together. The base is re-checked for flatness and the gauge is ready for use.

SAFE THINKING

Accidents other than very minor ones are a rare occurrence in the workshop, and very severe ones even rarer. As a result, safety can frequently become an aspect of the workshop which is given scant consideration. Joe Ginn in this article prompts us to give more thought to the subject. Much of what he writes is common sense, but still easily overlooked. However, there are some items which I am sure will be new to many readers.

Let it be said from the beginning that I am neither a killjoy or a prophet of doom. On the contrary, in retirement my workshop gives me a great deal of pleasure and it is my sincere wish that you may enjoy your favourite hobby in complete safety, the trick is "Think Safe - Be Safe".

When you have a spare moment try making a list of the possible hazards you may encounter in your workshop, here are a few possibilities for you to think around.

Rotating machines:

e.g. Lathe, Mill, Drill Grinders etc.

Hand tools:

e.g. Saws, Files, Hammers, Chisels etc.

Electricity:

Dangers from faulty wiring, careless use. Fire, burns and dangerous clothing. Whilst using a flame asphyxiation, inhalation of injurious fumes.

Head injuries:

Caused by collision with objects.

Eye injuries:

Caused by flying metal particles.

Foot injuries:

Caused by dropping heavy objects.

Falling:

Caused by tripping over objects on shop floor.

Now let us look at the above list in detail with a view to accident prevention.

The lathe

The main cause and most severe injuries are sustained by hands coming in contact with rotating chucks or work pieces. Beware of the dreaded faceplate, with angle plates, dogs, balance weights etc. Rotating at a rate of knots this can be lethal. Touch only when stationary, talking of which, don't rely on the counter shaft clutch. Switch off the motor, better safe than sorry. Never take a piece of emery to a rotating work piece, especially a bore, with your fingers. If you must use paper, use emery on a stick; sticks are replaceable, fingers are not. Likewise if you must file in the lathe, make sure the file handle is well fitted and your hands are well clear of the scene of a possible accident.

Milling machines

Mills, both horizontal and vertical, have rotating cutters with nasty sharp teeth. Make sure cutters are quite stationary before touching work, they usually overrun after switching off. Never clear away swarf whilst running, and if you apply coolant by hand do it with a long handled brush (the bristles won't last long) or squirt it! When I bought my mill/drill they wanted me to buy a guard that looked like a fish tank and cost a bomb. A thing like that would knock all the pleasure out of milling. I would sooner give up the hobby than be forced to work under such restrictions. A mandatory requirement in industry, no doubt, but if you think safe you can enjoy your milling unrestricted.

Drilling machines

Always use sharp drills, less chance of breakages and I know it's a bind but always clamp the work to the table. This is essential with any drill over 1/2in. dia.; even under this size it may not only save your hands but certainly save you bent drills when they jam or break through. I have a box full to prove it! When drilling large holes it is better to start with small drills and work up in stages to the required diameter.

Grinding machines

Tricky one this, the Perspex shields provided on most grinders makes off-hand tool grinding near to impossible. Personally a pair of good clear goggles that fit over my specs are the things for me, these should be hung over the machine so that you do not forget to put them on. There are a few safety points to remember, *never*, but *never* run wheels without the metal guards in place and don't stand directly in front of the machine when you switch on. Adjust the tool rest so that it is as close to the wheel as possible and check it regularly, wheels wear down with use and, if the work piece is dragged down between the rest and the wheel, the results can be disastrous. A wheel revolving at thousands of RPM can fragment and spread itself around like shrapnel! Perhaps a few words regarding the fitting of grinding wheels would not come amiss.

Fitting grinding wheels

It is a job not done too often and the safety procedures may not be too well known. The first thing to establish is that the new wheel is compatible with the speed of the machine, the operational speed is marked both on the wheel and the machine. Before fitting the wheel, thread a piece of string through the hole and suspend the wheel, then give it a light tap with a piece of wood. It should ring clear; if there is any suspicion of a cracked sound discard the wheel. Make sure a paper disc is in place either side of the wheel, these are usually fitted to the new wheel, but if not make two from thick paper or cardboard. Always use properly designed flanges either side of the wheel and do not

overtighten the wheel retaining nuts (one left hand, one right hand thread).

Important, replace the wheel guards, reset the tool rest. Make sure the machine is not plugged into the mains, revolve the wheels by hand to make sure nothing is fouling. Plug in, stand to one side and switch on. Leave to run for a short while and use lightly at first. That's the safe way of doing it.

Hand tools

Hacksaws are probably the most likely hand tools which can cause hand injuries. These are usually caused by punching the vice due to sudden uncontrolled breakthrough of the cut. One book by an eminent technical author illustrates on the front cover a hand holding a hacksaw with the index finger extended along the frame! Don't do it, you'll be sorry! I was. Of course you should listen to the cut and break through carefully, but sometimes we are only human and impatient, then ... ouch!! Reach for the plaster.

Screwdrivers

If you are holding an object in your hand (a three pin plug is favourite) and the screwdriver slips, you can give yourself a nasty stab. If possible use a vice or make sure that if the blade slips it will miss your hand.

Files

Little danger here, except for filing metal rotating in the lathe, a dangerous practice to be discouraged. Never use a file without a handle and make sure that the handle is suitable for the job, and well fitted.

Hammers

Make sure heads are not loose on shafts and that shafts are not split. Also, *never* strike hardened steel.

Chisels and punches

Not too often listed these days but the same observation goes for drifts; that is, never let the head develop a jagged mushroom, grind a chamfer on the head.

Spanners

Open-ended spanners can be a great barker of knuckles, particularly when working in confined spaces, such as motor cars. If possible use ring or socket spanners. In cases where open ended spanners must be used make sure that they are the correct size and use with care.

Electricity

We are told, leave it to a qualified man, up to a point I would agree, but I have my own ideas how I like my workshop wired, I strike a comparison. My workshop is on its own isolated circuit professionally installed up to a distribution board. Beyond that it is wired the way I want it - I undertook this work myself. If I should move house I remove all my own wiring back to the



Use a mains plug with an almost foolproof strain relief cable grip. Pulling wires from their terminals, especially the earth terminal, is probably the main cause of potential danger. Mark the cover with the item being connected. This may avoid something being started in error. Fit the correct size fuse. Use tough plugs, do not be tempted to use damaged plugs.

Non-spectacle wearers should purchase and use a pair of safety specs for all instances of possible danger, no matter how slight.



board. If you know enough to do your own wiring you don't need any advice. But I feel I must say the following, make sure all machines are earthed, each machine can be isolated from the supply. All plugs and points are fused down to minimum requirements and the floor is covered with non-conductive material. Unless you try sticking wires into the three pin socket with a screwdriver in the earth hole you should not get into trouble and if you do try that you have asked for it! A final word, always switch off the master switch when you finish work.

Fire

Electrical fires are unlikely if you observe the above. Any form of open flame work like silver-soldering should not be undertaken within the workshop. I know it's tempting to use the Taymar canister type blowlamps in the shop but these lamps are top heavy; they can be easily knocked over or dropped. I have thoughts about making a stable base to fit the canister. If you are using any form of propane or gas flame plant it may be safer to use it in the open air, but not very effective, as the flame becomes invisible and it is blown by the wind which also cools the work. Not many of us are able to set aside a purpose-built area for brazing, welding etc. The only suggestion is to remove the car from the garage, make sure that your site is well cleared of all flammable material, work in the middle of the bare concrete floor and leave a door or window open. If you do have a fire extinguisher (and you should), make sure you are familiar with its use. If you don't have an extinguisher, at least have a bucket of water handy. Last but not

least, and I cannot impress this on you too strongly, do not wear anything made of nylon or the like while you are working with anything hot, because if you happen to just touch nylon with anything hot like metal the nylon will fuse solid and sink into the flesh. That's bad enough, but it's worse when it is picked out. Other man-made materials have the same properties – especially some socks – be warned.

Asphyxiation

It is unlikely that there could be fatal results but this can be quite unpleasant. Most of us have smallish workshops and fumes from meths, aerosols, etc. can make you feel quite ill. If you have to use

solvents keep the shop well ventilated. When paint spraying a cheap mask is beneficial. These are good things to wear whilst turning cast iron also.

Head injuries

Largely a matter of workshop layout; cupboard doors, if wall mounted at head level, can be a menace. Try not to store anything heavy above eye level. I find I hit my head most often by dropping things on the floor then bending down to pick it up and crack! The lathe, the bench vice, saw, milling table, all conspire to get you when you are vulnerable! My worst point is the cross slide handle on the mill, I wish it were made of rubber! I have even tried wearing a safety helmet but find this too uncomfortable. Motto, think before you bob up, use your head, not crack your head.

For those with long hair this is a thing which must be guarded against, especially when using small round belt drilling machines. I have the best possible guard: it's called baldness!

Eye protection

Protection of the eyes is an important point. I do advocate wearing the big overall goggles that I use for grinding to be worn for long periods. I have consulted my optician about industrial spectacles; he assures me that my normal prescription, provided I use plastic lenses, should be adequate for our class of work. But I would like some side guards and intend to make some in Perspex or polycarbonate material. If you are fortunate to have good eyesight take care of it. Clear plastic protective spectacles can be obtained, why not use them? A jeweller's eye glass or optical loupe is always useful in the shop, particularly when reading verniers.

Foot injuries

This has been my most serious injury in years of shop working and on more than one occasion. Dropping even quite small pieces of metal on toes can be very painful. Once I dropped a big piece; I won't bore you with my stupidity, but believe me it hurts! Wear stout shoes, but even Toetectors are no substitute for safe thinking. Remember, most damage to the feet is avoidable by using the head.



Spectacle wearers should purchase and use a face mask whenever the additional protection is considered the slightest bit beneficial. Even non-spectacle wearers may prefer these, as they do not limit the field of vision as may spectacle frames.



A spring, mounted on a chuck key, makes it impossible for it to be left in the chuck when the machine is being started.

Falls

The moral of this one is keep the workshop tidy and the floor space clear. Watch out for leads from drill guns and other appliances draped across the floor. Try not to store things so that you have to climb to get them, store at low or ground level, if possible.

If you have come this far with me you will, no doubt, have more ideas of your own, for you are now beginning to think safe. Even a white painted box with a red cross on it displayed in a prominent position will make you think. I trust that after reading this you will never had need

for its contents. Remember we practice this most pleasurable of hobbies for the satisfaction we get from doing so. We are not and do not wish to be bound down by all the vagaries of the Factory Acts; no doubt very necessary in industry but not applicable to the pleasure workshop. These, however, can be dangerous places. Injuries are far from pleasant and curtail our pleasure and can effect our livelihood. Like car driving the essence is accident prevention. A few precautions, a little forethought, and above all safety thinking. If you have read this article, you may not agree with my views or may well be far more knowledgeable than myself but if I

have saved just one person from injury it has been worthwhile and we both owe our thanks to the editor for printing my thoughts on the subject. In closing I wish you many safe and happy hours pursuing the best of all pastimes.



Have at least some first aid items available.

Emery cloth alternative

A good way of polishing work in the lathe is to use "Scotchbrite" utensil cleaning pads instead of emery cloth. A fine finish is achieved and the pad is long lasting. Normal safety precautions should, of course, be observed.

Alan Jeeves



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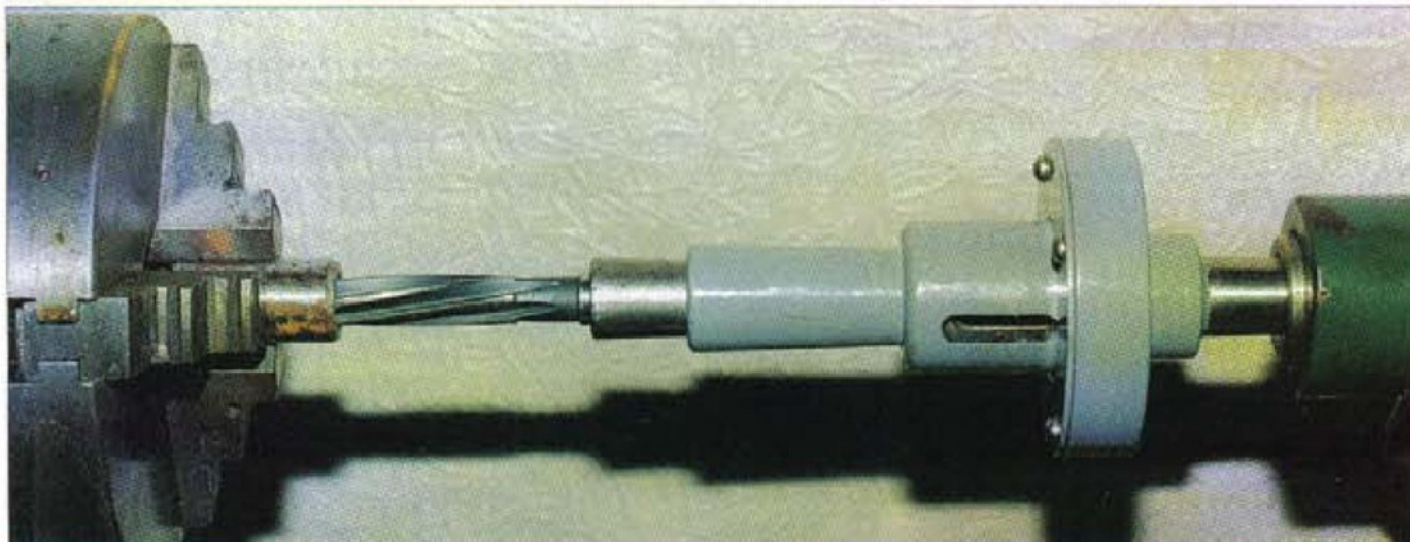
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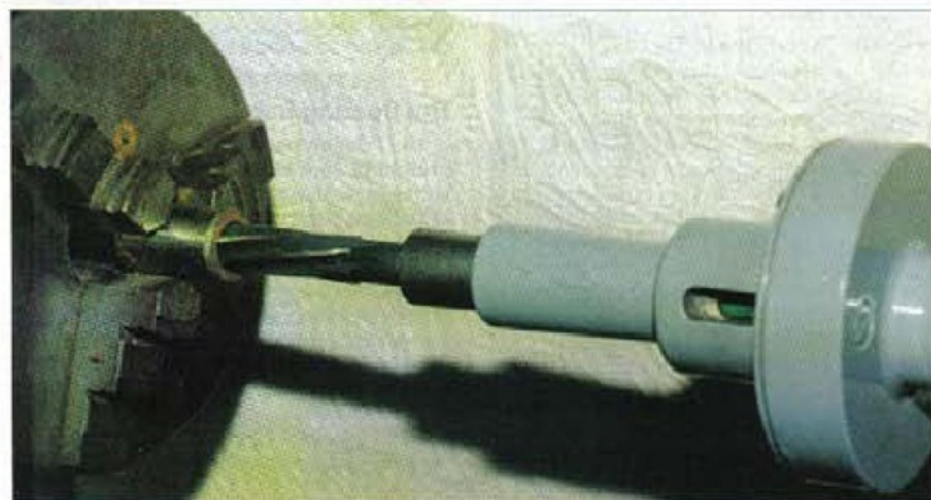


0.2 - 300kW



A: View of reamer chuck in lathe.

FLOATING REAMER CHUCK



B: Reamer chuck in use.

When reaming a drilled hole in the lathe, in order for the reamer to cut to exact size the tailstock must be exactly in line with the headstock. If there is any misalignment here it will be reflected in the fact that the finished hole ends up oversize. I wonder how many home shop lathes can boast that the centre line of the tailstock is dead in line with the centre line of the headstock all the way down the bed.

My own shop is equipped with around 50 good machine reamers which come in very useful when close tolerance holes are required to be produced on model making or tool making jobs. To drill and ream a hole can be much quicker than setting up a boring bar and boring out to the exact size, especially in the smaller diameters and even more especially if the hole to be produced is a deep one.

If you purchase a new reamer for a job you have probably just parted with quite a

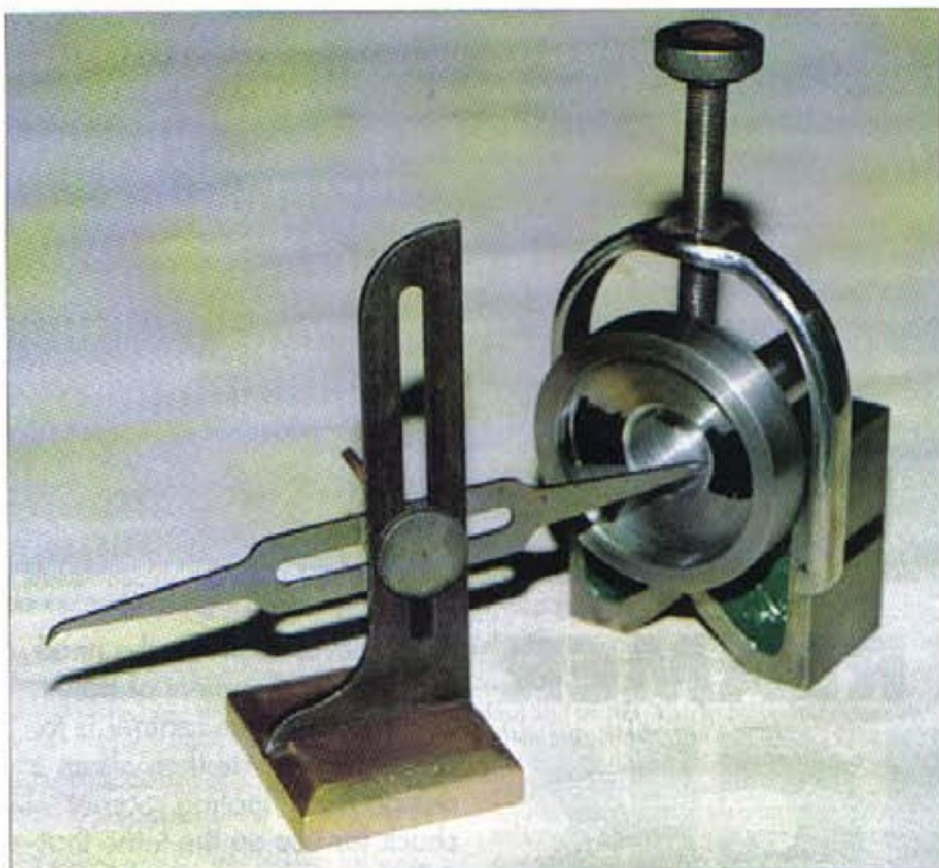
lot of money in return for a very high quality, precision cutting tool. The manufacturers have gone to great lengths to ensure that their product is of a standard which is demanded by modern industry. The reamer is, alas, only as good as the machine with which it is to be used.

I know some craftsmen who, requiring an accurate hole, will drill it out leaving it around 0.13mm undersize and then hand ream the hole with a suitable reamer and tap wrench. They do, of course, end up with a hole of the desired accuracy but blind holes can be a problem because of the taper designed into hand reamers. The reason that the hand reamer cuts to size is that it is allowed to find its own centre as it proceeds down the pilot hole, and is not influenced by any misalignment of the tailstock which might cause it to cut oversize. In other words the means of driving the reamer is allowed to "float". What we are going to do here is to produce

Alan Jeeves explains the need for precise alignment of hole and reamer if the reamer is to cut exact size. He then offers a design for a floating reamer chuck for use on the lathe that will ensure the required accuracy of alignment is achieved. It would appear from the design that Alan works in the larger sizes. However, it should not be at all difficult to scale it down for smaller lathes and reamers.

a means of holding and driving a machine reamer which can be mounted in a tailstock that is out of alignment with the headstock (and therefore the pilot hole) yet it will still cut to size, ensuring all the efforts invested by the manufacturer in the design and production of the reamer are not lost because of worn or out of true machinery.

A floating reamer chuck is nothing new. They have been used extensively in the past on capstan lathes where the rapid indexing of the turret may sometimes cause misalignment due to swarf being trapped between the locating surfaces. What I am describing is a very effective unit which can be manufactured by the average model engineer and when completed I believe will form a valuable contribution to all future reaming operations he undertakes. The example shown is one which I constructed several years ago. It was inspired by a similar one I had seen, but made to fit a specific lathe, has enhanced my model making considerably. So much so that I have decided to make another one and lay out the procedures of its manufacture here in order that anyone who is interested in this piece of equipment may own one themselves. The dimensions I have chosen are suitable for a No. 2 Morse taper reamer and a No. 2 Morse taper tailstock but they can, of course, be re-scaled to suit other requirements. I have made mine out of mild steel but there is no reason why cast iron cannot be used if it is more readily available.



C: Marking out drive key holes in body.



D: Drilling drive key holes.

Removing broken drills and taps

To drill out a broken-off drill (say in a casting), grind a masonry drill to the angle of a normal steel drill, run at slow speed, this will then often drill hard materials.

Ken Gibson

Starting work

The main body (item 1) can either be turned from solid or fabricated (as I prefer) from two pieces welded together. If it is turned from solid the best method will be to rough out the dimensions, leaving a couple of mm oversize as a contingency against the blank moving in the chuck due to the large amount of stock which must be removed. The roughed out blank can then be re-chucked and the Morse taper can be turned on by whichever means the engineer favours. I usually set my compound slide using a test bar and DTI. Anyway the taper shank is formed and if

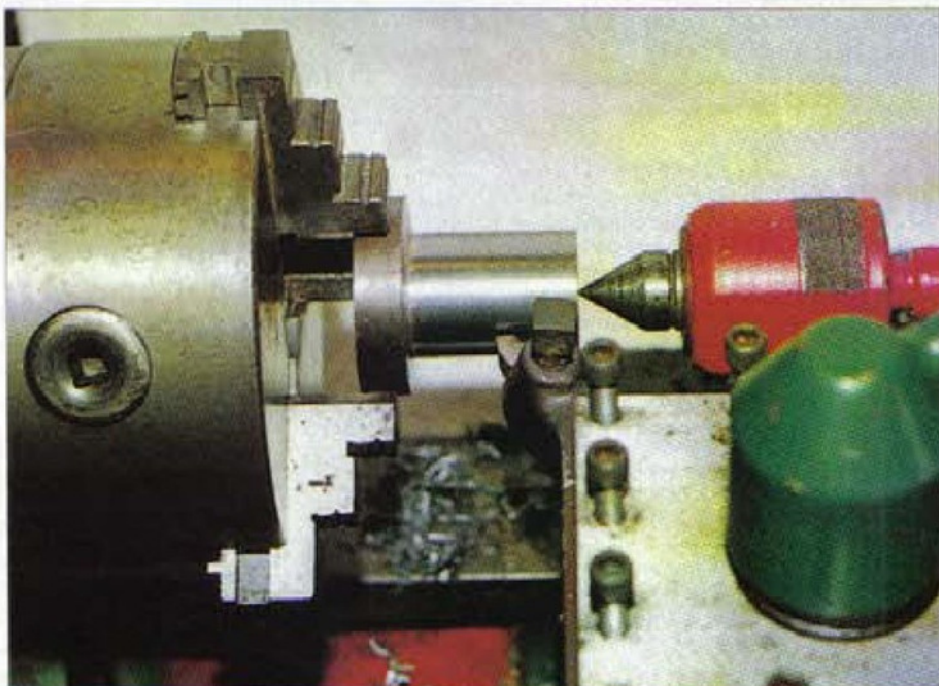
the option of a tapped hole and threaded pin (photo J) is taken up as a method of ejecting the reamer chuck from the tailstock (as opposed to the conventional tang which is milled on) a standard M/T sleeve can be used as a gauge. If a flat tang is going to be milled on it is as well to do it now if you still want to use a standard sleeve as a gauge.

Once a good taper has been machined and the 28mm dia. finished, the whole body can be turned round and located directly into the spindle nose of the lathe to complete the machining of the second side. The 22mm clearance hole is there to clear the tang of a 3-2 M/T sleeve (item 5) which we are to use as a means of holding the actual reamer but some of the sleeves are of a quality which allows the tang to be sawn off with a standard hacksaw blade, as in photo "J". Tangs can also be removed with an abrasive cutting wheel (e.g. angle grinder). The tang on this sleeve is of no use to us whatsoever.

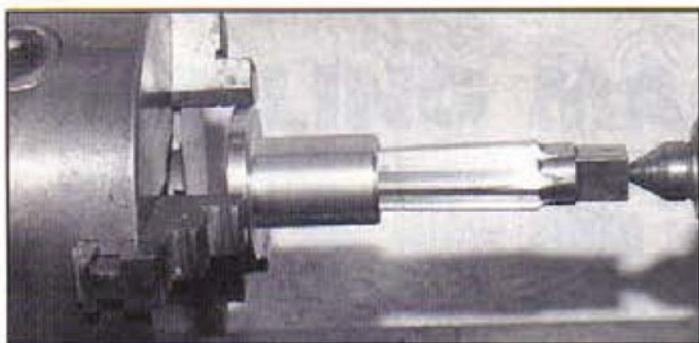
Whilst the body is in the lathe a PCD can be inscribed (60.5mm dia.) and this circle will aid the marking out of the four M3 tapped holes. As an alternative these holes can be 'spotted through' the retaining plate (item 3) later. The job can be taken from the lathe and the drilling of holes undertaken. The reason for the four M3 screw holes to be drilled at 45 deg. to the two 4.5mm dia. drive key fastening holes is that if round head screws are used in these four holes (to secure the retaining plate) they will not encumber the drill drift when ejecting a reamer after use.

The floating head

The floating head (item 2) is a straightforward enough job. The No. 3 Morse taper is machined to accept the 3-2 M/T sleeve (item 5) which should not project from the back face in excess of 18mm as noted on the assembly drawing. The two 10.0mm wide slots at 9 o'clock and 3 o'clock allow the head to 'float' in one plane, whilst the clearance in the drive keys allows movement in the other (photo 'I').



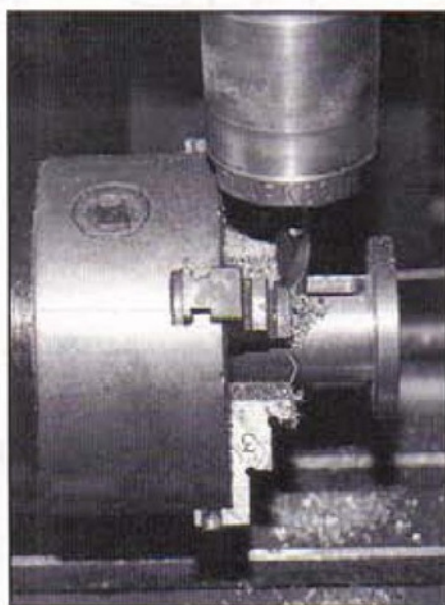
E: Turning floating head in lathe.



F: The option of reaming the M/T in the floating head.

Table 1
Diameters of reamers in relation to shank

No. of M/T shank	Imperial (in.)	Metric (mm)
1	Up to 0.5512	Up to 14
2	0.5513 to 0.9062	14.001 to 23.019
3	0.9063 to 1.250	23.02 to 31.75



G: Milling the slots for the drift in the floating head.

It will also be seen that the diameter of the flange on the head is 3mm clear on the body. This clearance is also there to enable it to float. The 25x8mm slot has to align with the slot in the M/T sleeve (item 5) to allow the drift to pass through. The standard sleeve can then be pressed into the floating head (ensuring that the slot is in alignment with that of the head) and the resulting object can be offered to the body to ensure that the tang is clear within its 22mm dia. housing. The back face of the floating head must be square with the bore.

Drive keys

The drive keys (item 4) are made from 5mm thick strip and drilled and tapped. They are screwed onto the body (item 1) and when the floating head is placed in position it should be a sloppy fit. When pressure is applied to the reamer in use, it is the back face of the head against the internal face of the body which keeps the reamer square with the work. The clearances elsewhere allow the reamer to find its own centre and thus cut to size.

Retaining plate and assembly

The floating head is held in place with the body by the retaining plate (item 3) which can be made from a disc of mild steel. It is gripped on the OD then bored and faced. It can now be turned round and a bore grip taken in the chuck. The second side is faced and the OD turned to size. The spigot is turned to fit the 53mm. dia. dimension of the body and a 60.5mm PCD put on similar to the body. All sharp edges are removed and the four holes (3.5mm

dia.) are drilled. If preferred these holes can now be spotted through and transferred onto the face of the body ready for drilling and tapping.

The individual parts can now be assembled, using grease between the sliding surfaces of the body and floating head. The retaining plate is slid over the taper socket (item 5) and screwed home. If a tang has not been provided on the shank of the body (item 1) an M6 pin (item 8) will have to be screwed into the end which extends 19mm from the tail. This enables it to be ejected from the tailstock.

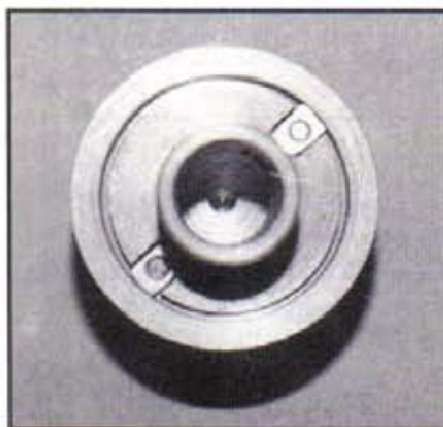


H: Milling the drive key slots.

Using the chuck

In use, with a reamer fitted to it, the chuck becomes a fairly long unit as can be seen from photo 'A' and it is recommended that it be guided with the left hand as it is fed into the work using the right hand on the tailstock wheel. When a suitable reaming allowance is left in the drilled hole this new piece of equipment will produce a first class reamed hole of accurate dimension. I include a small table (table 2) of reaming allowances which I have found to be suitable over the years.

This method of holding the reamer will



I: Front view of floating head in the body showing clearances.

Table 2
Recommended reaming allowances

Dia. of hole	Reaming allowance
10mm (3/8in.)	0.3mm (0.012in.)
10 to 14 (7/16in.)	0.4mm (0.016in.)
14 to 30 (1 1/8in.)	0.5mm (0.020in.)

allow the tailstock to be in excess of 1mm out of centre to the right or left of the centre line of the machine as the floating head will align itself exactly with the hole being reamed.

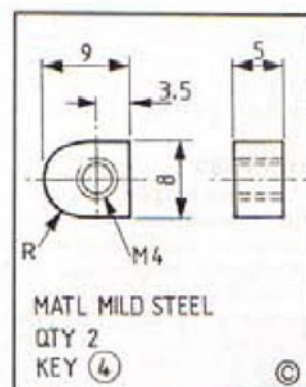
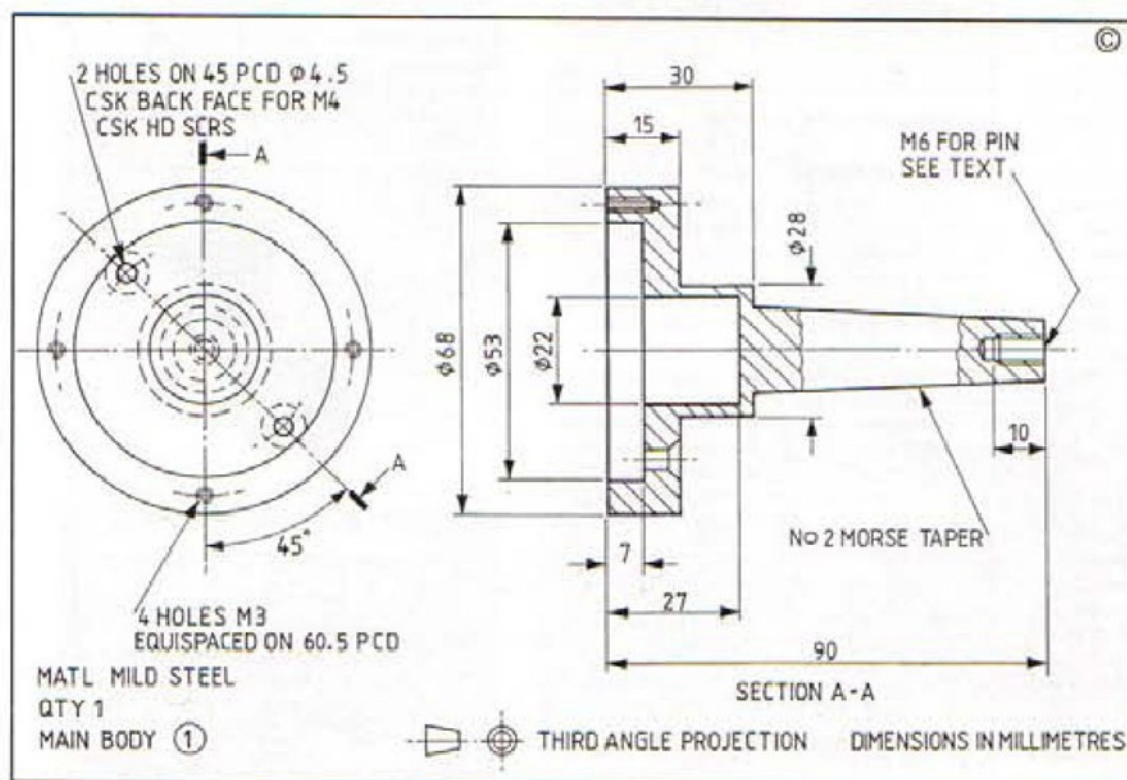
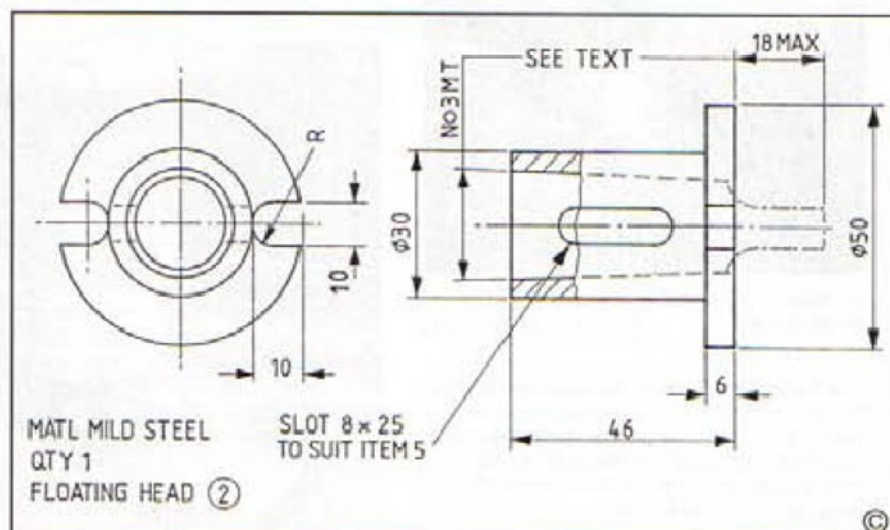
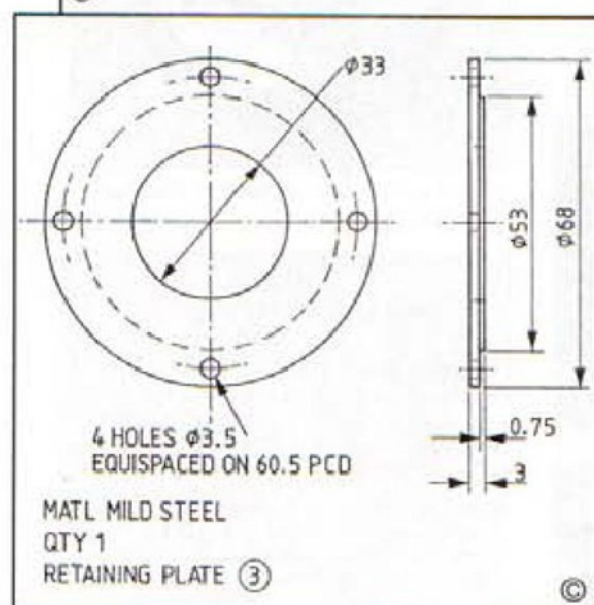
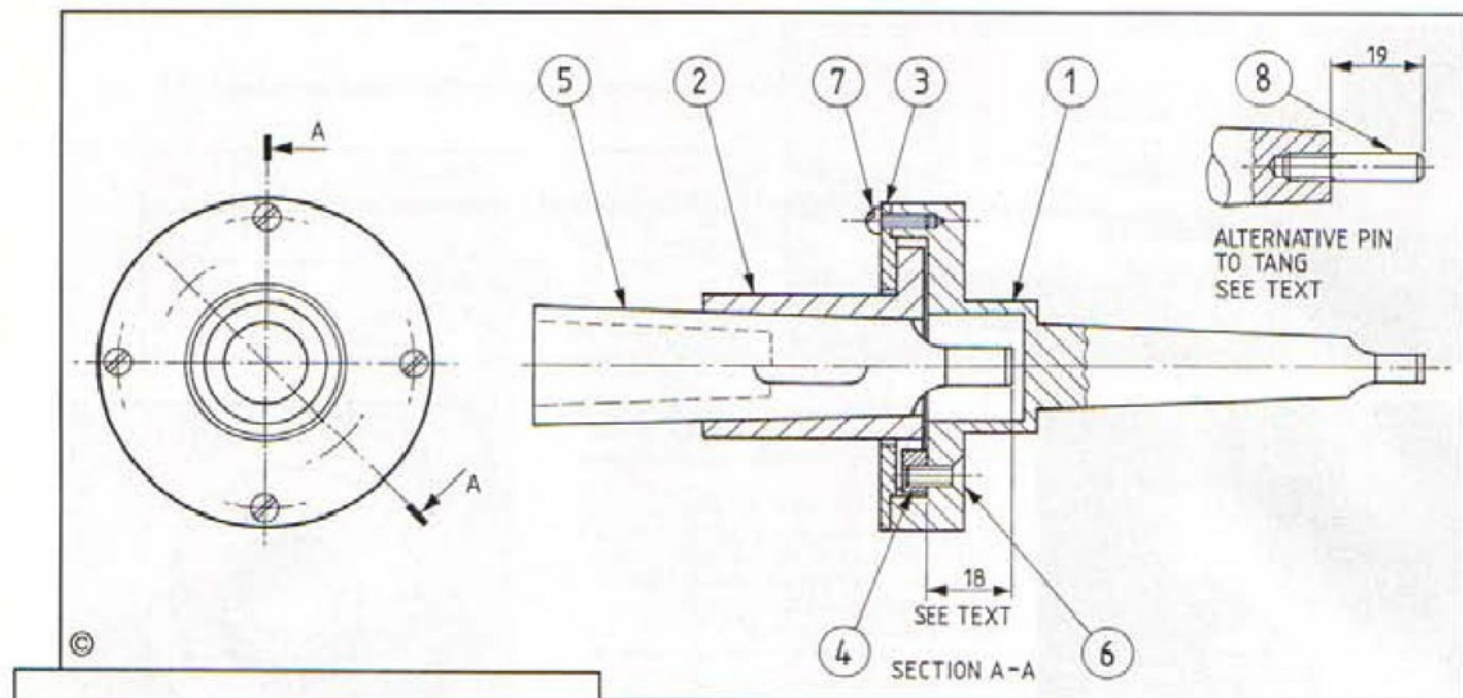
A further table (table 1) outlines the maximum diameter of reamer for a given Morse taper shank and may assist in selecting a scale in which to make your own floating reamer chuck, appropriate to the type of work it is intended to ream.



J: Component parts of reamer chuck.

Cutting list

Item and quantity		
1) 70 dia. x 92 long (112 long if a tang is to be machined on).	1 off	m/s
2) 55 dia. x 42 long.	1 off	m/s
3) 70 dia. x 4 wide.	1 off	m/s
4) 8 x 5 strip min. 20 long		m/s
5) 3-2 morse taper sleeve	Purchased	
6) M4 x 12 long c/sk screws.	2 off	
7) M3 x 10 long r/h set screws.	4 off	
8) M6 x 35 long screw (optional).	1 off	



Softening jaws

If the hard jaws in your lathe chuck are worn and have to be replaced, the old ones can be annealed with suitable heating equipment, and re-used as soft jaws.

Alan Jeeves

DRILLING MACHINE SAFETY

John Steele suggests a professional approach to one aspect of drilling machine safety, by fitting a No Volt Release starter and foot switch. It is of course worthy of consideration for other machines

There have been a number of mentions in articles, and readers letters, regarding the often underestimated dangers of using the humble drilling machine. Many of these have discussed the necessity of being able to stop the machine easily and quickly in the event of a mishap. The method of initiating the emergency stop has mostly been by the inclusion of a foot switch.

In keeping with most items proposed in *MEW* for the workshop, the suggestions have been for an economy approach to the problem. In these cases, the method has been to connect the foot switch directly into the supply line to the motor. I feel that where matters electrical are concerned, there will be many who will be prepared to spend more, resulting in an industrially acceptable method.

In the article on my experiences in setting up a small workshop from scratch, (*this issue Ed.*) I indicated that my purchases were of Hobbymat lathe and mill/drill, together with a Clarke drilling machine. To my pleasant surprise, both lathe and mill/drill were fitted no volt release starters. In keeping with most economy drilling machines the drilling machine had just an on/off switch. It is fitted with, apparently separate, start and stop push buttons but, like many machines, these are mechanically coupled to a common switch. This is really just the equivalent of a manual rocker switch.

No volt release

For the reader for whom the term No volt Release is not fully understood, I will briefly explain. Power to the motor can, in addition to the switch on the machine, be removed by a number of methods. These are typically, the switch on the power supply socket, removal of the plug from the socket and a power supply failure, "outage" I think is the term for our American readers.

With a simple on/off switch on the machine the machine will stop and restart if it is disconnected and reconnected by any of these other methods. This can create potentially dangerous situations. Typically, if a machine is switched off by removal of the plug at the socket, but leaving the switch on the machine in the on

position, the machine will start, maybe unexpectedly, when the plug is placed back in the socket at some later time.

In the case of a no volt release starter, (N.V.R.) the start button will require pressing again, should the supply be interrupted by other means.

Reference to the typical schematic diagram should make this clear. If power is removed from the starter as a whole, contactor "C" will become de-energised and contact "C" (terminals 13 and 14) will open. It will then be necessary for the start button to be pressed so as to energise the contactor coil, and once again close contact terminals 13 and 14.

Another advantage of a commercially available N.V.R. starter will be the inclusion of an motor overload protection device. This is an essential item for a guarantee to be honoured, should a new motor fail. Again I was pleased to see that the Hobbymat mill/drill had an overload device in circuit. I am unsure of the situation regarding the lathe, as the diagram in the manual was not the latest issue.



1: The units as purchased. The main assembly, to suit the required voltage, and the overload unit, to suit the motor nameplate current.

Obtaining a starter should not present a problem as such devices will be obtainable from most local electrical wholesalers, see Yellow Pages or similar. Being an armchair buyer, I went for mail order and purchased mine from Electromail. The starter will have to be purchased in two parts, the main portion being the case complete with contactor, (the name for a relay intended for switching higher loads, in particular, motors.) and a separate overload unit, as illustrated in **photo 1**.

Limited overload setting range

The reason for the two parts is that the contactor will be suitable for a load of from a fraction of an amp to around 16 amps, but it is not possible economically to design an overload unit to cover this range. The actual situation for those supplied by

Electromail, is 11 units covering the range 0.21 to 18 amps. Typically one which would suit many home workshop machines has a range of 3.5 to 5.4 amps.

While one contactor unit will cover the range, there are two to choose from. The reason being that most will be used on three phase and the coil voltage of the contactor will be, in this case, suitable for 380 to 420 volts at 50 Hz. For home workshop use, and with single phase motors, a coil voltage of 220 to 240v 50 Hz is available. These values, for the one I purchased from Electromail, and made by MTE, are typical for all other makes.

Incidentally, Electromail do supply other makes.



2: The light duty metal enclosed foot switch.



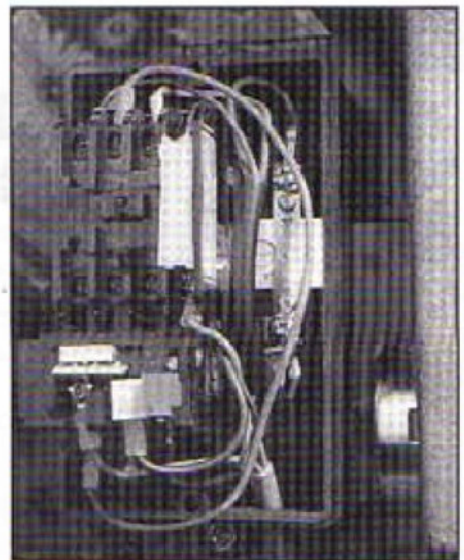
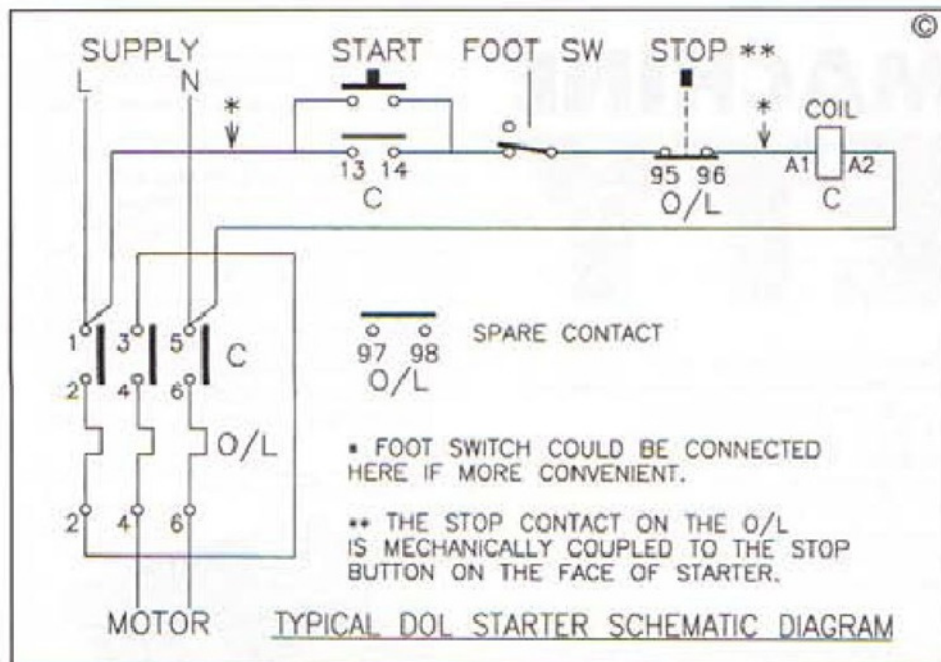
3: The foot switch is not totally enclosed and, whilst the ingress of swarf is unlikely, the terminals have been encapsulated in resin adhesive for total safety.

Obtaining a foot switch

Having chosen the starter, a foot switch had to be decided on, and again a commercially available unit was chosen. In this arrangement, the foot switch does not actually switch the motor, but is used to remove the supply from the contactor coil. Being of the no volt release type, the starter will not re-energise when the foot switch is released.

A foot switch could easily be constructed for this duty using a simple micro switch in a suitable enclosure. The one I choose was from Electromail, being a light duty model at around £15 and seen in **photo 2**. This is not perfect for the situation as it is not enclosed to the standards industry would demand. An industrial switch enclosed to IP65 (*IP numbers will be covered in the MEW data book - Ed.*) will cost around £40.00.

The light duty switch is made of two small boxes one pivoted on the other, the larger being on the top. Entry of fragments of swarf would be very unlikely if used the correct way up, though I must admit not totally impossible. Opening the switch up is



4: The inside of the starter in the course of being connected up.

easy by just removing the two pivot screws. This reveals a simple micro switch partially shrouded from the metal exterior. For total peace of mind, shrouding was easily accomplished by the application of a little resin adhesive over the small solder tags onto which the incoming connections are made. This is illustrated in **photo 3**. The switch comes with a 2 metre length of cable already fitted.

Connecting up

Connecting up the system is not difficult but two points are worthy of special mention. First, and the most likely to be overlooked, is the requirement to ensure all three elements in the overload unit are carrying current. The units are made for industry and will invariably be used with three phase motors, in this situation it is not economical to make units specially to suit single phase (two wire) use. Motors used on three phase will frequently continue to run if a phase is lost, maybe due to a blown fuse or a disconnected wire. They can, under some conditions, start with one phase missing. Without going into the reasons, which are outside the scope of the article, it is preferable that the overload becomes more sensitive under these conditions. This is termed "Single Phase Protection".

If, for single phase use, only two elements of the overload were connected, this would cause the calibration of the overload unit to be incorrect. To overcome this, the live wire is routed back through the central element, the single wire from bottom to top, seen in **photo 4**, is achieving this aim. As the overload unit connects direct onto the contactor, **photo 5**, the third contact in the contactor is also in circuit.

The second consideration for connecting up the system regards the connecting of the foot switch. This has to be connected so that it interrupts the supply to the contactor coil. It is probable that any unit purchased will have with it a connection diagram and will show where external stop devices can be connected. If not, the typical diagram with this article will help. There is a high degree of standardisation with regard to these starters, as a result, it is



5: The overload unit fits direct onto the contactor, no power connections are necessary.

probable that the terminal numbers will largely conform to this diagram, irrespective of the make of the unit.

The main point to conform to is that the foot switch should not be connected in the neutral line. The reason for this is, that a short to earth on the lead between switch and contactor coil would not cause a fuse to blow, as it would do on the live side, therefore the system would continue to function. The result of this would be that when the foot switch was operated, current would then flow to earth, rather than to neutral, but the contactor would remain energised, and the motor continue to run. This would be particularly dangerous if the operator normally stopped the machine using the stop button, using the foot switch for emergency use only. For a similar reason, it is essential that the line and neutral incoming wires are connected correctly. That is, so that the line is on the side of the push buttons etc., and the neutral on the side of the contactor coil.

Photo 5 shows the contactor removed from the enclosure and the overload unit fitted. Fitting the overload unit to the contactor is an easy operation, using a clip at the bottom, and the three tags just visible in **photo 1**. These slip into the terminals on the contactor which are then tightened.

The actual operation of connecting up caused few problems. The existing push button switch was removed from the machine and the cables released, fortunately these were long enough, if only just. With the existing switch removed a suitable bracket was made up to place the new starter in the position shown in **photo 6**. This was considered the preferable position, as it made the start button easily accessible. The new bracket was mounted using the obsolete fixing positions for the switch just removed.

The incoming supply was connected to the top of the contactor, which is the norm, and the motor to the output terminals of the overload unit. Two or three internal connections, as per the diagram supplied, arranged to suit single phase, completed the wiring except for the foot switch.

The foot switch is fitted with a changeover contact, and fully wired with three leads. The contact which is normally closed, and opens when the switch is pressed, is the one to be wired in. If the common side of the changeover switch is connected towards line, rather than towards the coil (both arrangements will work) the third wire will become live when the switch is pressed. It is therefore essential that this wire is safely insulated by some means. Probably the easiest, and



6: The starter in the operating position.

safest, is to anchor it in one of the terminals for the spare contact (97/98) on the overload unit. This contact closes when an overload occurs, and its main purpose is to signal, in much more complex systems, that an overload has occurred, probably by switching on an indicator light.

Earthing integrity essential

Finally, the integrity of the earth connections must be ensured. The starter is provided with, as will also other makes, a suitable method of anchoring the earth leads, seen on the right of **photo 4**, so this is a relatively simple operation. With modern practice the enclosure is plastic so

an earth lead out to the drilling machine is desirable, rather than just relying on the lead to the drive motor.

Close examination of **photo 4** will show, though this was taken before the installation was complete, that there is an absence of any strain relief on the connections leaving the enclosure, this of course is taboo. However, what the photograph does not show, is that the cables are firmly anchored to the machine just outside the enclosure, this can be seen in **photo 7**. This is an essential requirement, especially for the foot switch which could move around and cause quite a strain on the terminals. If you are tempted to make up your own system you are unlikely to save much cash if you purchase individual contactor and overload. Do bear in mind that if you attempt to use a relay these are only intended to switch their rated current, whilst a contactor is designed to make and break at least eight times its rated current. This is to cope with making the starting current and breaking the current under fault situations.

Worth every penny

Having now completed the installation, there is something reassuring about being able to switch the machine off without having to remove one hand from the operation in progress. I do therefore consider the money very well spent.

Supplier details.

Electromail, PO Box 33, Corby, Northants, NN17 9EL. Tel. 0536 204555 Fax. 0536 405555.

Editor's postscript

It occurs to me, that many readers may wish to fit a starter as suggested in this article, with or without the foot switch, but

to a lathe which is presently fitted with the popular Dupar drum reversing switch. In this case the starter should be wired between the mains supply and the input terminals to the switch. That is to say that the two connections shown going to the motor should be connected to the switch terminals.

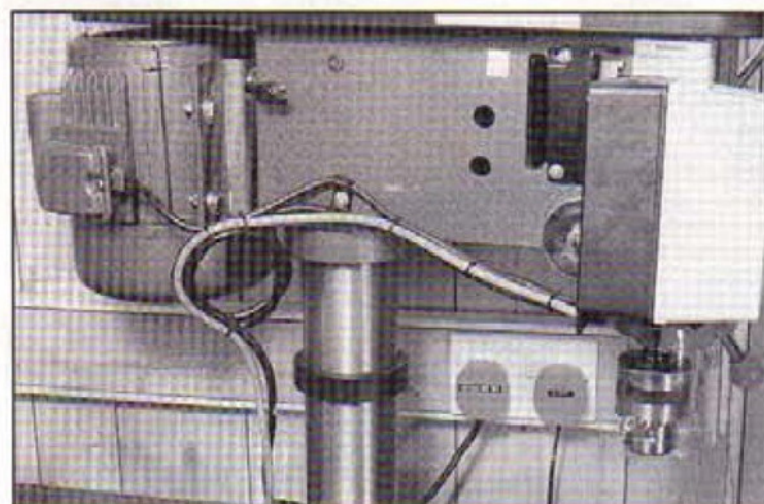
While this will function, it has the distinct disadvantage of defeating the no volt release feature, should the motor be switched off using the reversing switch. As this will have been the method of switching off the motor prior to the starter being fitted, it will be an easy mistake to make.

It is therefore, essential that the switch is made to drop off the starter when it is moved to the off position. Fortunately, when being used for a single phase motor, as in **sketch 2**, there is a suitable spare contact, terminals 4 and 8, that can be connected into the stop circuit in the same manner as that proposed for the foot switch above. This contact is made in both the forward and reverse positions, but is open in the off position, it is therefore exactly as is required.

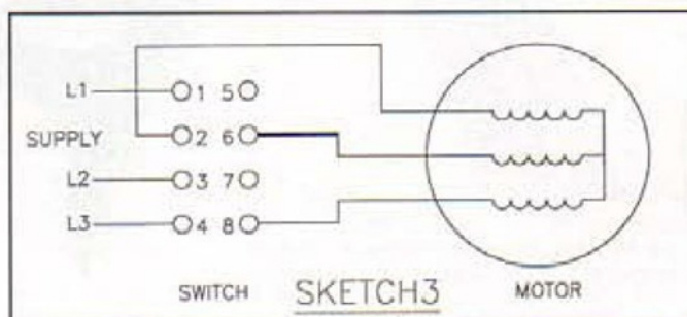
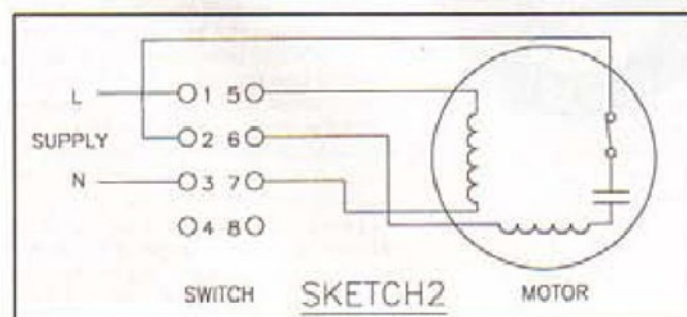
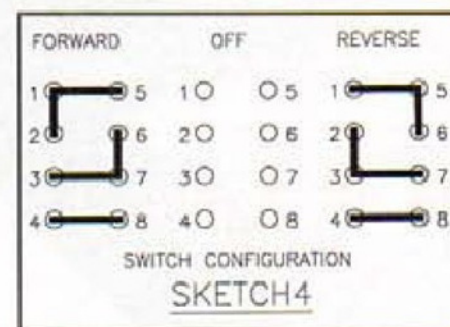
Should the switch be connected for reversing a three phase motor the situation is more complex. In this case, the circuit is as in **sketch 3** and contact 4/8 is in use. However, it is not involved in reversing the motor, this being done with the other two phases. Its purpose is only to switch power to the third phase and this can adequately be done with the starter now being fitted.

The contact should therefore be disconnected and the third phase of the motor connected direct to the third phase output from the starter. This will then make the contact 4/8 available for connecting into the starter stop circuit.

I have taken up the idea of fitting a foot switch to the starter on my Myford Series Seven, using a heavier duty foot switch available from Electromail, but still not totally enclosed. In fact the construction is similar to the one referred to above. If both a foot switch and a reversing switch are to be fitted, then the two are simply connected in series and, as a pair, connected into the starter stop circuit in any of the positions indicated on the diagram.



7: The cables securely anchored to prevent any strain on the terminations inside the starter.





1

1) A simple depth gauge protractor.

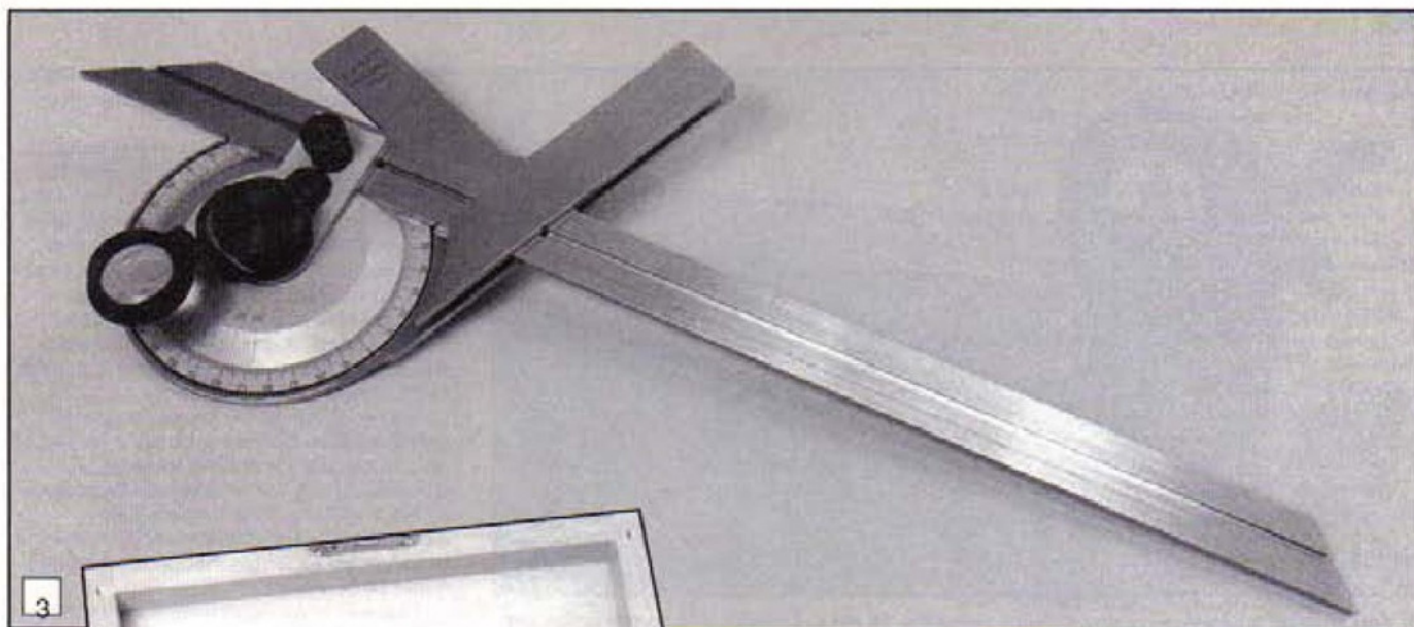
MEASURING AND MARKING OUT ANGLES

Working to specific angles is one of the lesser requirements in the home workshop, but when they are needed can present quite a problem to the operator. Here we consider the options available for carrying out this task. In our next issue the construction of a simple device for measuring or marking out, of angles will be described.

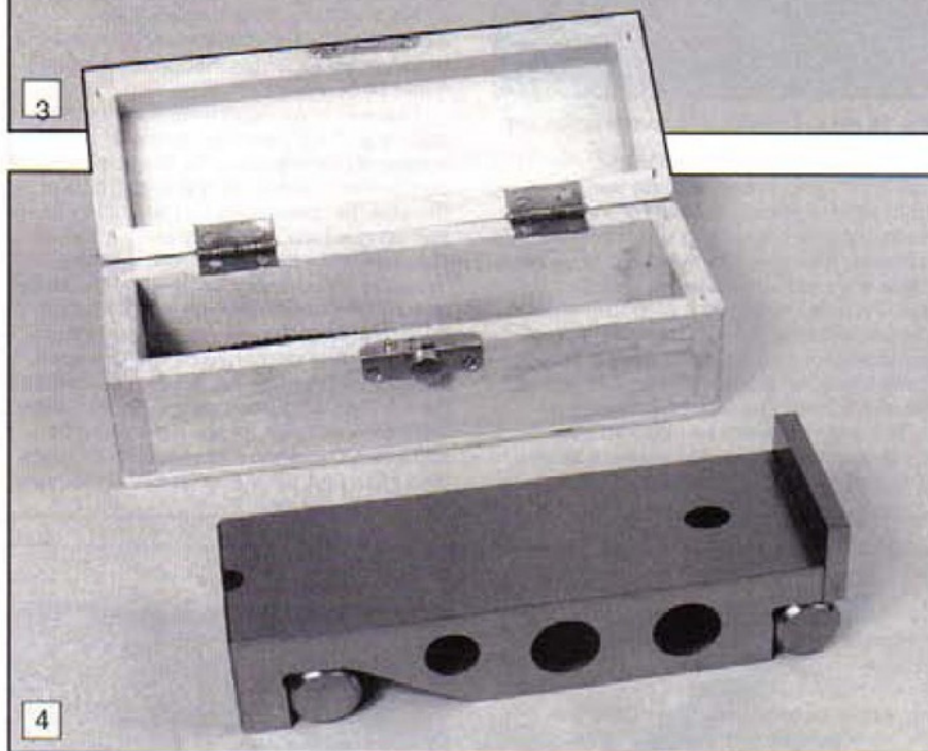


2

2) A combination set, comprising protractor, square and centre finder.



3) A universal bevel protractor.



4) A 5x2in. wide sine bar.

Of all the requirements in the home workshop for measuring, marking out and setting up, those including the need to work with angles, other than right angles, are probably the least likely to be undertaken. If precision be included as a requirement then it would be easy to say that they are virtually non-existent. There are however instances such as placing holes on a PCD, or even more important the cutting of a gearwheel, where angles are involved and precision is essential. However these are almost invariably achieved using some type of dividing device, and the fact that precise angles are involved is not such a problem.

However, the use of precise angular setting to divide a circle into a number of equal division is not impossible. A method using a Clinometer was described in a letter from a Mr Thomson and published in *Scribe a Line* in issue number 8 (Feb/Mar 92). (For the many new readers who will not have this issue, an extract is printed at the end of this article.)

Another requirement in the home workshop for a precise angle is when turning a Morse taper, again the angle is normally forgotten, or more likely never known, as it is almost always established by trial and error, comparing it with the

mating taper.

On the other hand, there are occasions when angles are involved but where the actual value is of little importance. One such situation is the turning of a taper on a handle, as may be used on the end of a lead screw; here the requirement will be for the top slide to be set over a deg. or two and the taper turned, probably just making adjustment until it looks "right". Similar situations can occur on the milling machine where a large chamfer, or similar, might be machined on a component for appearance, or perhaps even weight reduction.

Requirement for precise angles

There will however inevitably be occasions when there is a requirement for more precise angles; in these instances some additional aid will be essential. These requirements can be many and varied and so any advice must be general rather than specific; they are likely to occur in distinct areas. Ignoring the lathe where the calibration of the top slide will frequently be sufficient for angular setting, the requirements are likely to fall mainly into the following situations.

1) Marking out components by means of hand tools.

2) Setting up parts on the surface plate prior to marking out.

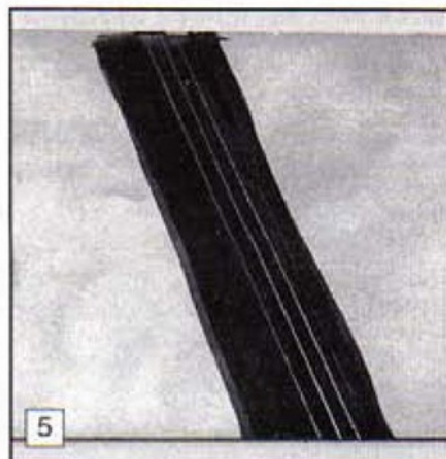
3) Setting up parts on an angle plate, or in a vice, prior to machining, either on the milling or drilling machine.

Methods available

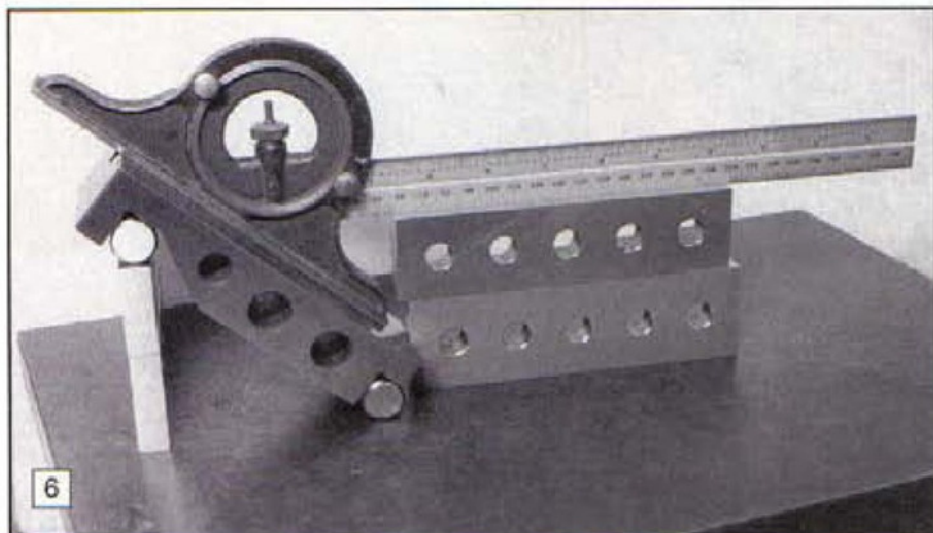
Obviously the accuracy achieved will depend on the method, and the quality of the instruments, being used. It is not possible to precisely quantify the accuracy of the various methods, as there will be variations between makes for the same type of equipment. For example, a good quality plastic drawing office type protractor could be more accurate than a poor quality combination set. Even so, providing good quality items are purchased, the following is likely to be the order of preference when accuracy is the requirement.

- 1) Plastic drawing protractor.
- 2) Simple depth gauge protractor (photograph 1).
- 3) Quality combination set, not one of the cheap die cast types (photograph 2).
- 4) Universal bevel protractor (photograph 3).
- 5) Sine bar (photograph 4).

As an example of accuracy, photograph 5, shows a piece of steel



5) A 75mm wide sheet marked at a given angle using the items seen in photographs 1, 2 and 3. No distinguishable difference is present.



6) Transferring an angle established with a sine bar to the protractor of a combination set.

plate being marked out using methods 2, 3 and 4 above. It can be seen that any difference between the three methods is minimal, the width of the plate was about 75mm. However this test was for the three items to hand and is no guarantee that other makes will perform similarly. The depth gauge protractor was of unknown manufacture, but had the appearance of being well made. The combination set was a very old item, but with a new rule, made by Brown and Sharp, and the universal bevel protractor was East European by Toolmex.

Items 1 to 4 are all for conveying the angle from the device to the component, or alternatively the reverse, that is measuring an existing angle. Item 5 is for setting up an angle with the use of additional components, which is then conveyed to required location, perhaps using one of the tools in 2, 3 or 4. **Photographs 6 and 7** show examples. The reason why a sine bar would be used to set the angle, rather than using the instruments own calibrations, is that the sine bar is much more accurate than the other methods; more about that later.

Considering accuracy, the items as listed above are likely to be in order of accuracy, and assuming they have been made to a reasonable standard the following should be achievable. The drawing office type protractor should be able to achieve a result within 1 deg., while the depth gauge protractor would probably get to within 30 minutes. In the case of the combination set, 15 min. should be possible. The universal bevel protractor, with its vernier type setting, is much more accurate being able to be set to within 5 min., however even this is bettered by the sine bar which should achieve better than 1 min., for angles of less than 45 degrees.

The combination set

I feel that very little needs to be said with regard to using items 1 and 2 as their use and limitations should be obvious. The combination set is, as its name implies, a more universal tool. In addition to the protractor head, which really is the subject of this article, a normal square with facilities for 45 deg. is included, as is a centre finder, these additional items can be seen in **photograph 2**.

The protractor head usually has as a

fitting into the central rotating portion, a spirit level, this can be used for the measuring, or the setting up, of angled surfaces. It cannot however be claimed that these are precision levels, as was explained in the article relating to a precision level in the April/May 92 issue. There are two considerations when using this facility, these being, whether the setting of the vial is correct, and how sensitive it is.

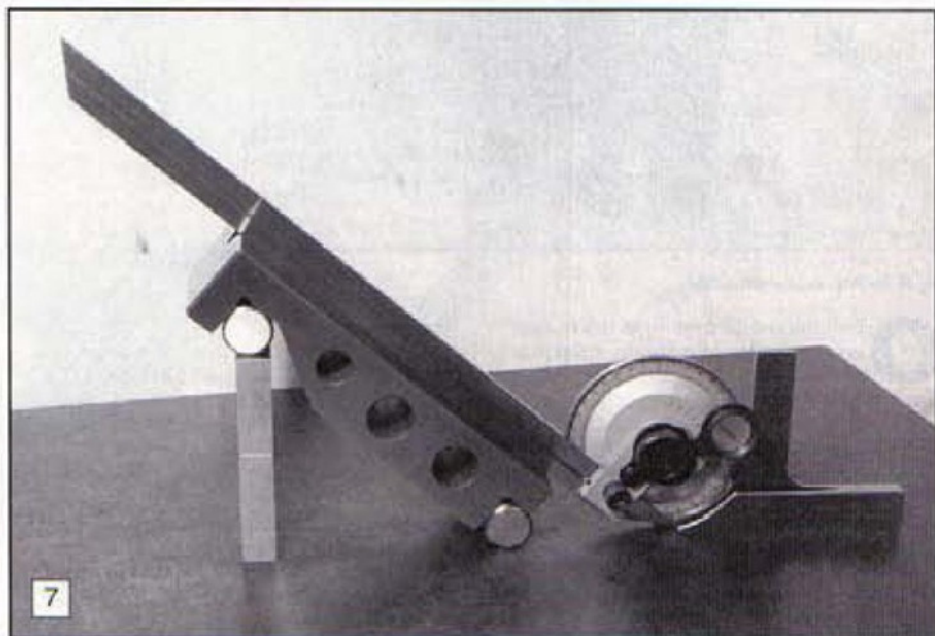
The first can easily be checked by setting the protractor to zero deg., place a short length of rectangular bar in a vice and

hopefully the protractor will be found to be accurate and no compensation therefore necessary.

The other factor equally, if not more, important is the sensitivity of the vial. To test this, set up a level surface in the vice as above checking it with the protractor level, with this done, set the protractor to one deg. and return it to the level surface to see how far the bubble has moved. If the movement is 2mm, as it is on the one I have checked, it should be very easy to detect a variation of 10 min., that is 0.3mm bubble movement.

Earlier in the article it was suggested that a combination set protractor should be able to be set to within 15 minutes. Combining this with the possible accuracy of reading the level will give us an estimated combined accuracy of 25 min., in practice it is probable that better than this could be achieved.

This will in no way compare with the accuracy of a Clinometer, but will frequently be adequate for the setting up of components, either on the angle plate or in the vice, for machining on the drilling or milling machine, it will depend on the machine table being level in the first instance. It could also be used on the lathe to achieve divisions which are not easily available from change wheels or dividing plates, as was described by Mr Thomson, it is doubtful whether this would be adequate for the manufacture of gears, but would be eminently suitable for the machining of squares or hexagons, or marking off holes on a PCD, and other less crucial operations.



7) Using a sine bar to set up a universal bevel protractor.

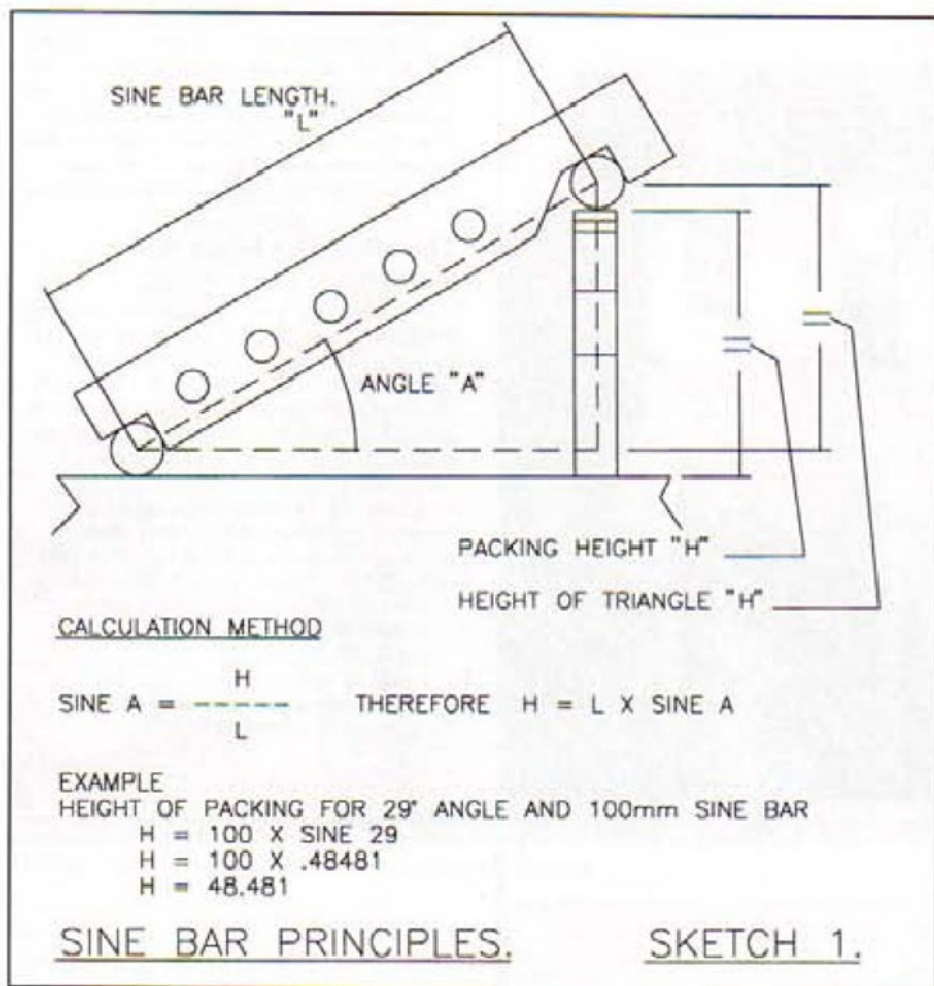
adjust its position until the vial indicates level. Now rotate the protractor through 180 deg. and if the level is accurate it will still read level. If it does not, adjust the bar in the vice until the error indicated is identical with the protractor in both position, at this stage the bar is level.

Now adjust the protractor till the vial reads level; at this point the error can be read off the protractor scale, and if a note is made of this it can be compensated for on any subsequent occasions when accuracy is important. Some readers may be prepared to add an additional cursor line for use when the level is being used,

The combination set is a quite expensive item, probably costing from around £80 to £100 for one from a quality manufacturer, typically Starrett or Mitutoyo. I would not advise purchase of one of the economy die cast sets for use in precision work. However, the items that make up a combination set are frequently available individually, and a protractor with rule only is likely to be about half these prices.

Universal bevel protractor

This item is a precision piece of equipment having a comparable level of precision, construction and finish to that of



Morse taper being checked by this method.

Readers of this article who are unfamiliar with the sine bar, will have probably gathered from its name that it has a trigonometrical connection. **Sketch 1** shows the principle of the sine bar, from this it can be seen that the presence of the rolls make it such that only two dimensions are involved in determining the angle. These dimensions are the centre distance of the rolls and the height of the packing. With these two dimensions the angle can be calculated, or as is more likely, with the centre distance and the angle known, the height of the packing can be determined. Either of these calculations will be carried out using the formula, $\text{Sine of the angle} = \frac{\text{Length of opposite side (height of packing)}}{\text{divided by the hypotenuse (roll centres)}}$. Bars are commonly made with roll centres of 100mm and 200mm (also 5in. and 10in.), so with an easy dimension for the hypotenuse the calculations are easy, involving only the use of sine tables.

From **Sketch 1** it will be seen that the sine bar is not complete in itself, and for it to perform its function some addition packing in the form of slip gauges are necessary, also shown in **photograph 11**. The use of these is necessary, as the packing height can be any random value. This being easily achievable with the use of slip gauges.

For the reader for whom slip gauges are unknown the following is a brief idea of the content of a set. A typical set will have around 80 gauges ranging from 1mm to 100mm thick with the smaller ones in increments of 0.001mm, and larger increments of 0.01mm, 0.5mm and 10mm as the sizes increase. These would enable any size to be set up in 0.001mm increments, however, one additional gauge having a thickness of 1.0005mm enables increments of 0.0005mm to be attained.

The gauges are made to such precision that when used together, they will hold together of their own accord due to their level of flatness. It is no surprise therefore that these are very expensive. Whilst a good quality sine bar may be purchased for around £50, a set of slip gauges is likely to be £500 plus, a cost I would consider impossible to justify in any home workshop. However, in view of the ease with which very accurate results can be obtained, some reduction in the quality of bar and gauges, by the use of home made items, will still provide results which will be superior to the universal bevel protractor. This approach will be examined later in the article.

Coolant application

Any home workshop user who uses coolant for machining metals will find an empty washing up liquid bottle makes a good squeeze bottle for the purpose, and it's also mobile.

N. Smith

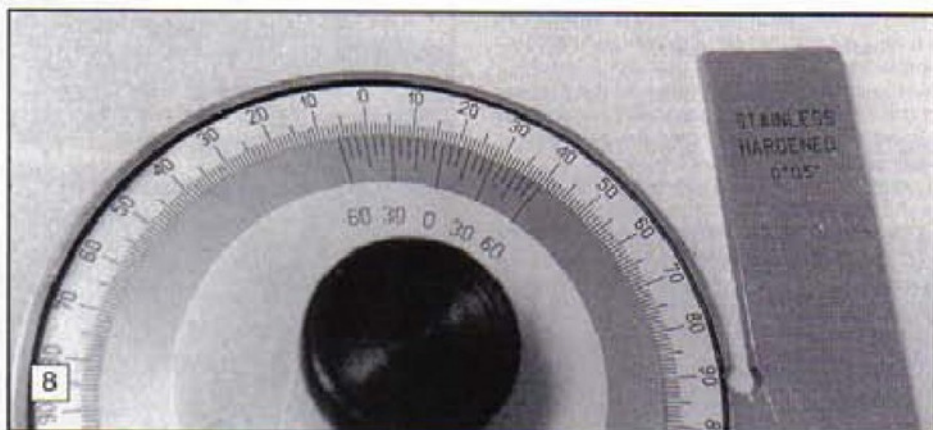
the more common hand vernier calliper. In fact its method of achieving its precise angular setting is identical to the method used for length setting of the hand vernier. The outer ring is calibrated in one deg. divisions whilst the inner vernier permits these to be further divided into twelve increments, that is five min., this can be seen in **photograph 8**.

From the recognised quality manufacturers their cost is likely to be comparable to that of a combination set, however good quality items from eastern Europe are available at around £50. If the low cost universal bevel protractor is considered relative to the protractor head only of a combination set they are of comparable cost. This does not make the universal bevel protractor automatically the best buy in view of its greater precision. The absence of the spirit level, and its more delicate construction, must be considered, bearing in mind its probable uses, there is no one answer to this question.

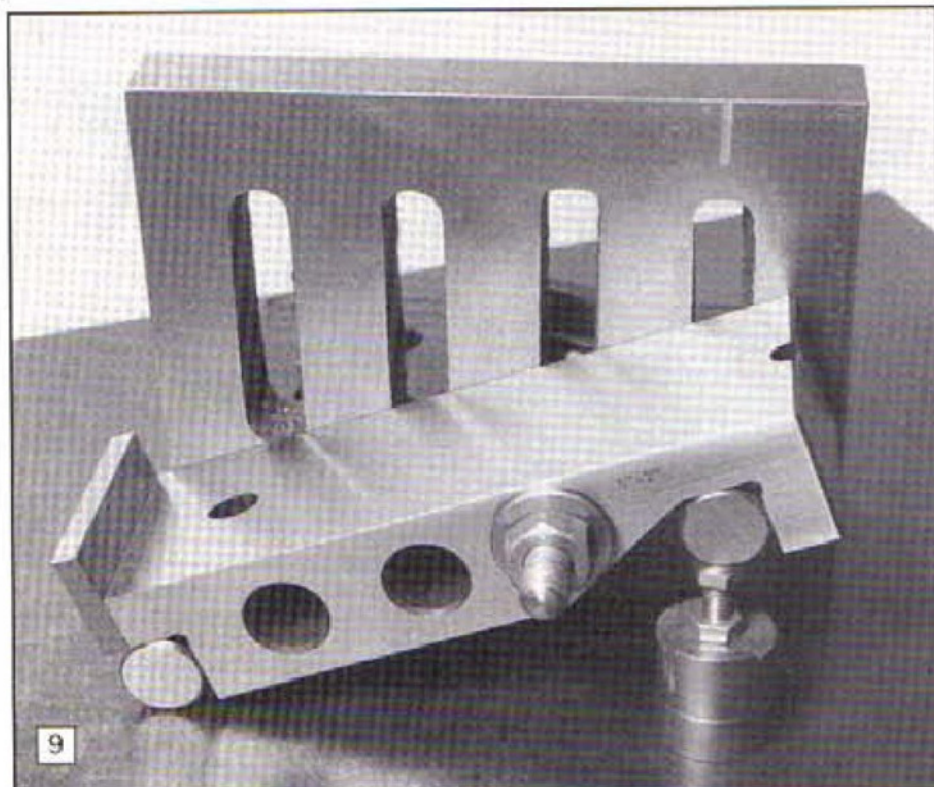
Sine bar

The sine bar, while capable of much greater precision than the other methods, has major disadvantages. Its use is limited to the setting up of angles on the surface plate and just possibly on occasions the milling table. These angles can be transferred from the surface plate to other locations using a combination set protractor, or a universal bevel protractor. Another approach is to convey the angle established by the sine bar directly onto an angle plate whilst still on the surface plate, **photograph 9**, then for the angle plate to be transferred to the milling or drilling machine for machining to take place.

In industry the sine bar is frequently used as a method of inspection, that is to say checking the accuracy of components which have been made to a precise angle. **Photograph 10** shows an example of a



8) Close-up of the vernier on a bevel protractor.



protractor gives it another plus.

If considering making a purchase along these lines you must weigh up the factors against the particular requirements of your workshop activities. (In the next issue of *M.E.W.*, we will be describing a device that can be made and which achieves good results aided by a normal vernier calliper.)

Thoughts on a home made sine bar

In view of the precision attainable using a sine bar I decided to consider what may be achieved with a home made set up. Taking the example in **sketch 1** in which the angle set was 29 deg., I considered the error in angle if the component parts were made to more typical level of home workshop precision.

Assuming all errors to be such as to have a cumulative effect, rather than possibly cancelling each other out, errors of 0.025mm (1 thou.) were considered.

Sine bar length, minus, 99.975mm
Roller diameters, one above packing larger by 0.025mm

Height of packing, plus, 48.506mm

These values give $\sin A = H/L = 48.531/99.975 = 0.48543$

9) Transferring a sine bar to an angle plate.

In use

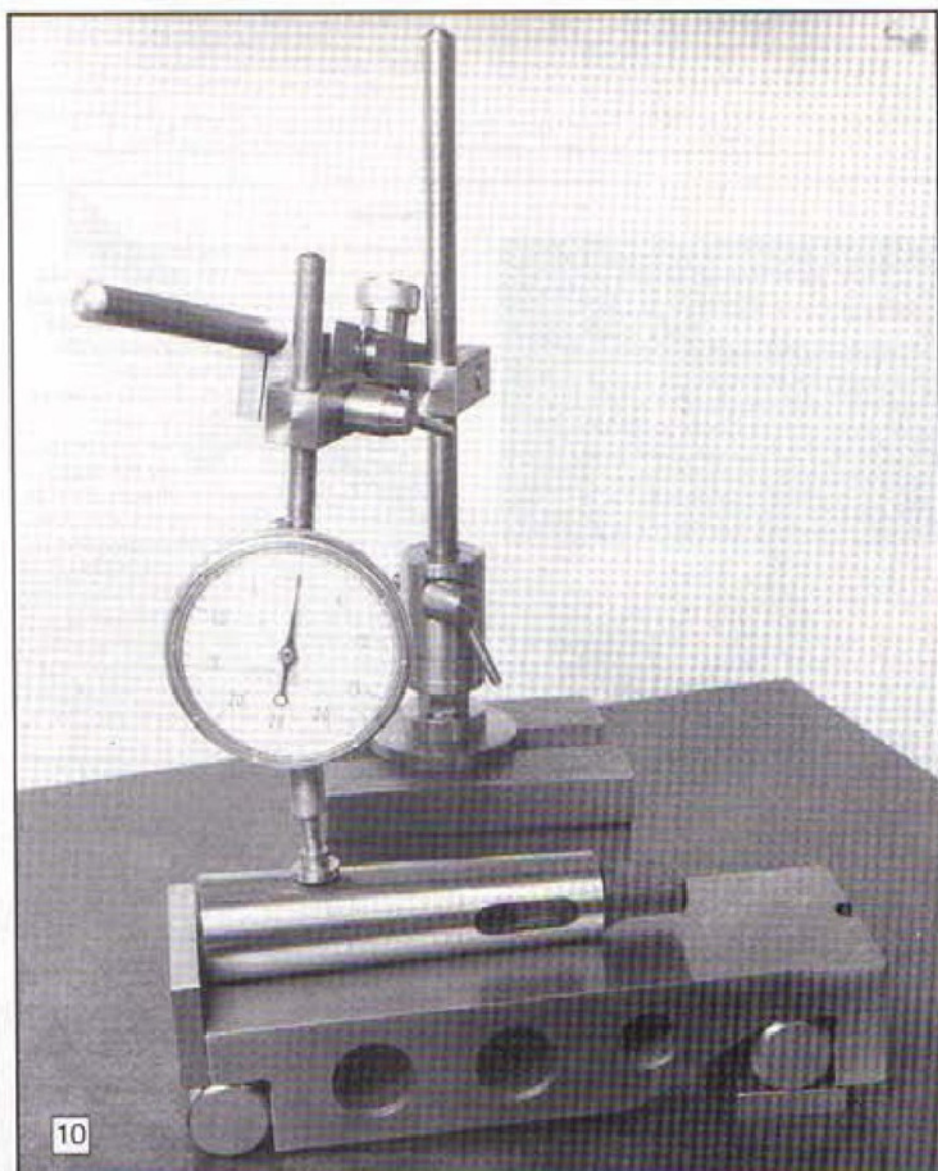
It is not possible within the limitations to the length of this article, to cover in detail the precise methods of using the items discussed, or their individual advantages and disadvantages, but some brief comments are probably better than none.

Photograph 5 showed that for marking out purposes, the accuracy is likely to be adequate for most applications no matter which of the three methods are employed. Therefore, ignoring accuracy, what are the considerations?

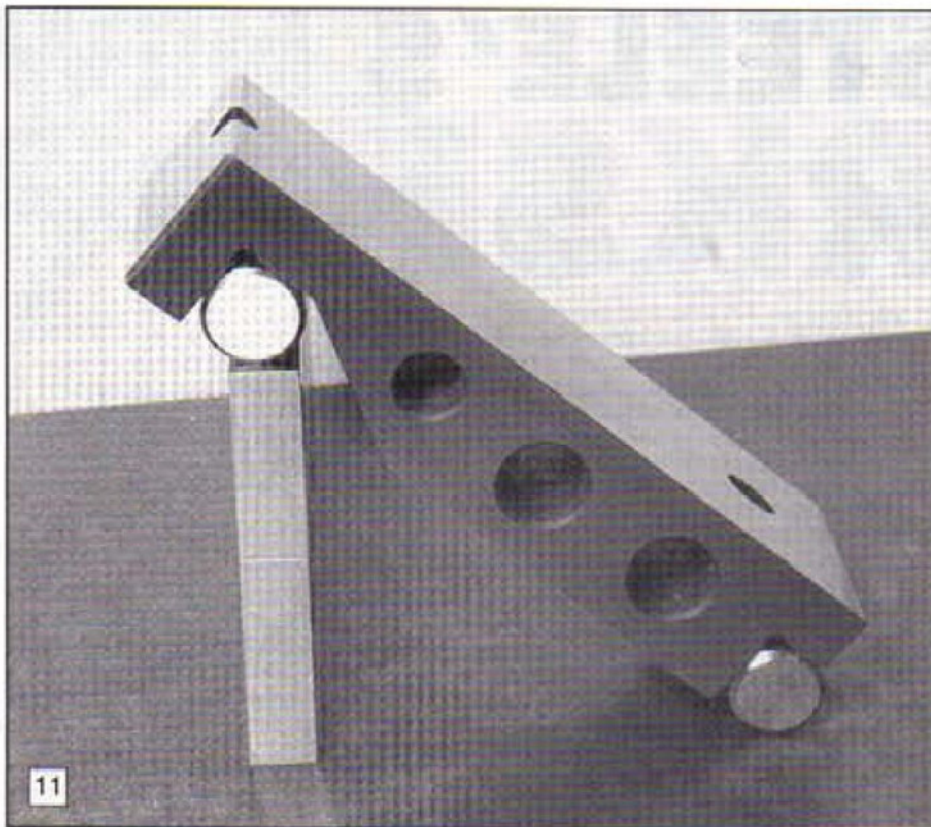
Probably the biggest problem when using any device for setting out or measuring angles is the problem of getting the device into the position to be set or measured. This frequently is more of a problem at shallower angles, but is not just confined to this situation. In this respect the universal bevel protractor is the easier to use for a number of reasons, but its half length bed, compared to that of the combination protractor, is a major factor.

Another plus with the bevel protractor is its angled ends to the arm. Consider measuring the angle of a dovetailed machine slide; in this case the square end of the combination rule would prevent it gaining access into the dovetail, whilst the pointed end of the bevel protractor would enable checking completely into the corner of the angle. The ends are made accurately 45 and 60 deg. so these can also be used for measuring in difficult situations, providing the required adjustment is made to the angle read from the protractor calibrations.

It must be considered that the delicate nature of the bevel protractor makes it more of an inspection instrument, whilst the more robust nature of the combination set makes it more at home in the confines of say a milling machine table. The combination rule is calibrated whilst that of the bevel protractor is not, and the presence of the vial in the combination set



10) Testing the accuracy of a Morse taper using a sine bar.

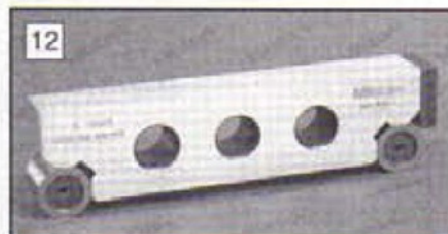


11) The angle of a sine bar being set up using slip gauges.

Therefore $A = 29 \text{ deg. } 2.27 \text{ min.}$, an error of 2.27 min., this is still better than can be achieved with the bevel protractor. Observant readers will have noticed that one potential error has not been included in the calculation; that is the deg. to which the top surface of the bar is parallel to the two under surfaces which rest on the rollers. As this error did not simply fit into the formula it was left out, in any case the errors considered should in practice be less than those used in the calculation. In this respect the error of 0.025mm between the two roller diameters should, with only a little care, be possible to eliminate almost totally.

The absence of slip gauges to set the height of the packing can be overcome by the use of a screw jack as seen in **photograph 9**. This is set for height using a micrometer. At least for the smaller heights it should again do better than 0.025mm. Even larger sizes, if the set-up is made with the use of a vernier calliper, should not exceed this error. As far as the length between the two rollers is concerned this does not have to be a precise dimension, so it can be made and the resulting length measured, again 0.025mm should be possible to improve on. If made like the Mitutoyo sine bar in **photograph 12**, measuring between roller centres will be much easier than the arrangement in **photograph 11**.

From these considerations, it can be seen that a home made set up should easily achieve better than 2 min., should this unlikely requirement ever occur in the home workshop. At this point however one important factor has been ignored, that is, the error in angle will increase with the increase in angle. This will be a factor even with commercially available bars, also there is a physical limit to which a bar can go. In the case of the bar seen in **photograph 11**, beyond about 70 deg. it becomes impossible to place the slip



12) A Mitutoyo sine bar, note the difference to that shown in photograph 11.

gauges in position.

Time, and space in this article, prevents me from considering the accuracy of systems, using either home made parts or precision slip gauges at these larger angles, I suspect that in practice beyond around 60 deg. it is considered preferable to rotate the approach and attempt to work in the order of 30 degrees. For precision work perhaps only up to 45 degrees.

An extract from Mr Thomson's letter

"The method of division which I have used for many years in my own workshop also confers this advantage, with little or no cumulative error. However as stated earlier, the necessary equipment would now be difficult to lay hands on. It relies upon a Clinometer made during the war years, as part of an artillery sight, to determine angle of elevation. It takes the form of a 45 deg. brass quadrant, detented at one deg. intervals, over which may be moved a radial bar, pivoted at the centre of the arc, which bears a moveable and very sensitive spirit level vial. Now the "trick" is, that this radial bar is not straight, rather it is slightly curved, at a constant rate, so that as the vial is slid along the bar, its slope gradually increases, as it progresses away from the pivot.

The vial mount carries a fiducial, that engages a scale engraved on the bar, and calibrated in minutes, which interpolate the detented deg. positions. Moreover, the glass vial itself, is subdivided into 30 sec. intervals, and such is their spacing, that intervals of circa 15 sec. may be easily judged.

In use this Clinometer is mounted on a transverse, 1in. square bar, pivoted at its centre on an expansive extension of the lathe mandrel, at the rear end, much in the same manner as the device described by Mr. Longworth. I also use a mandrel clamp of the split type, which bears on the outside circumference of the register immediately behind the chuck. This clamp is in turn anchored to a stanchion, screwed into the tapped hole, provided by Myford's, in the lathe countershaft casting, to accommodate their "Quick Change" collet attachment.

With the mandrel initially clamped, and the Clinometer on its transverse bar, adjusted to zero, the first machining operation is undertaken. This is followed by adjustment of the Clinometer setting to an angle equal to 360 deg. divided by the required number of divisions. The mandrel clamp is then released, and the mandrel turned until the vial bubble again centralises. The mandrel is then re-clamped, and the second machining operation is performed. This process is repeated for each subsequent operation until the step immediately preceding the 45 deg. limit is reached. At this stage, with the mandrel still clamped, the transverse bar carrying the Clinometer, is released on its expansive insert, in the rear of the mandrel bore, and returned to its starting position and zeroed. This is followed of course, by re-tightening the transverse bar pivot in the mandrel bore. Again the whole sequence of events is repeated, until the Clinometer setting once more reaches the step preceding the 45 deg. limit. In this way one may progress around the 360 deg. in stages.

Before starting work, it is best to divide 360 deg. by the number of divisions, to arrive at the angular subtense between individual divisions, and it is important to do this using a calculator which displays a fairly large number of significant digits. This figure, expressed in degrees and decimal degrees, is placed into a calculator store, and recalled for each subsequent operation, before applying the appropriate multiplier, in this way, cumulative error is reduced to vanishingly small proportions, bearing in mind that say 9 or 10 significant digits will be in use. Finally after each Clinometer setting is calculated in degrees, and decimal degrees, this is converted to deg. - minute - second format, for application to the Clinometer itself. My Hewlett Packard calculator as a pre-programmed, single key function, for this conversion."



Acquiring abrasives

A source of supply of lapping abrasives which is often overlooked is the lapidary equipment stockist. He can usually supply abrasives in small quantities.

Alan Jeeves

JOHN STEELE'S NEW WORKSHOP

Few readers will have the opportunity to build and equip a new workshop, largely from scratch. In this article, John Steele explains his experiences in doing just that. There are some interesting ideas that should be of interest to any reader refurbishing his workshop, such as the electrical installation that could quite easily be adapted to be used in an existing set-up.

Finding myself in the unexpected position of setting up a new workshop, including tools and equipment, I soon realised that there were more than just a few minor factors to consider. Not being, or intending to be, an avid modeller, or avid anything else for that matter, it was necessary to justify the expense on some grounds, what use would it be put to?

I felt that an interest in metalworking, particularly of the machine oriented type, was what I was looking for, and to a certain extent it mattered not what was being produced. To be more specific, activities revolving around extending the workshop's facilities would be number one on the list and would, initially at least, satisfy my urges to see the swarf spiralling from the workpiece. Perhaps eventually some small modelling projects could be envisaged.

The deciding factors

While establishing the workshop was a practicable proposition, it was fortunate that all the limiting factors turned out to be geared to the same result. This made the decisions easy to make, as there were few factors that were not demanding a similar solution. Factor number one for most people would be cost, in my case I could have spent more, however, other considerations limited me to what was really justifiable expense.

The question of cost was largely determined by the space available. This prevented me from buying larger and more expensive machines. It was because of limited space that my first major decision had to be taken. As I wanted a reasonably complete workshop, there would be quite a few machines with perhaps some additions in this direction, either made or purchased, at a later date. As a minimum, there would have to be facilities for turning and milling, plus a drilling machine and a bench grinder. It was concerning turning and milling

where the major decision had to be made. I could purchase a larger lathe, and with this, a bolt on milling attachment; the alternative to purchase a smaller lathe and a small vertical milling machine of compatible size.

The advantage of the first approach would be that the capacity of the lathe would be increased, and being the machine likely to get the most use this would be additionally beneficial. On the other hand, milling would then become somewhat restricted, and often more time consuming to carry out. Purchasing two smaller machines would limit the turning capacity but would make milling operations more acceptable. I liked the idea of owning what I considered a proper workshop. No offence meant to those who do not possess a milling machine and carry out this operation on their lathe.

about 0.8m. This would require one of the narrow sides to be supported on pillars. The final arrangement can be seen in **photograph 1**. There are three pillars, made from concrete blocks taken from old electric storage heaters, a piece of roofing felt between each block enabled them to be put together.

The workshop

Having now spent much time considering a wide range of possibilities regarding the workshop and the items it would contain, it was time to make progress with the construction. In view of the workshop's rather special site, I consider there is little point in going into detail regarding its overall construction. Perhaps a few points deserve a mention.

Being of a tidy disposition, storage featured high on the list of aspects to consider before the workshop was even built. The workshop was unlikely to provide a home for items not directly associated with the use of the workshop, as there was plenty of space for the DIY materials such as wood, paint etc., elsewhere. Items requiring storage, include small tools, raw materials, and a multitude of small parts such as screws. Even so, small machines have little affect on other items stored in the workshop. Smaller angle plates and chucks maybe, but the bulk of the items are likely to be equal in size, number and type. From this, I deduce, the workshop requires storage much the same as one, two or three times its size.

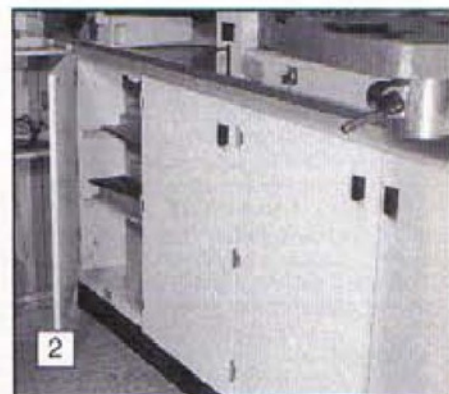
While the idea has developed over a period, it has only recently been built and equipped. This has enabled me to benefit from ideas in recent *Model Engineers' Workshop* reader visits. The article on the workshop of Alan Cambridge in issue 20 was particularly helpful. This persuaded me at the last moment, having already decided on more conventional benches, to go for enclosed cupboards, with some storage mounted on the rear of the doors.



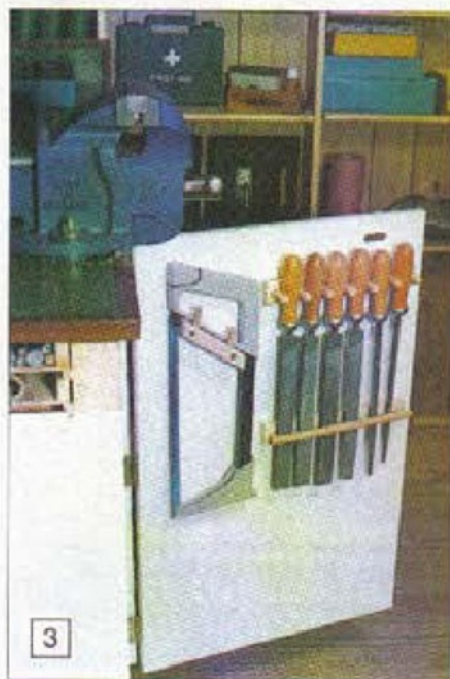
1: The rather unusual site for the location of the workshop.

A difficult site

Another consideration when choosing the machines, would be the peculiar situation where the workshop had to be built. Having frequently day dreamed about a new workshop for several years, I had already made the decision that it would be constructed on a solid concrete base, perhaps overlaid by a wooden floor structure. Having made this decision in the past, Murphy's Law dictated that it couldn't happen. The site on which the workshop (2.4m x 1.7m) had to be built, meant that it would overhang a 1m retaining wall by



2: Enclosed cupboards have been used for the benches.



3: Small tool storage on the rear of the cupboard doors.

The results can be seen in **photographs 2 and 3.**

This article also mentioned bench tops from flooring grade chip board, this is much denser than normal chipboard. The boards I purchased were dyed a light green colour, not all are, for what purpose I have no idea. This does give the bench tops a very pleasing dark green finish when the original colouring had been protected by

adding four coats of satin varnish.

The visit to Gordon Barber also decided for me the method of lining the inside of the workshop, which incidentally is of an all wood construction. Considering possible materials, produced only a short list; hardboard, plasterboard and plywood, probably 6mm. Hardboard is the cheapest but its tendency not to stay flat means that it probably requires more support framing, adding to the cost. Plasterboard lays flat but is difficult to achieve good joins. The option of plastering over this was definitely a non starter. Plywood, 6mm thick, seems the most likely method to adopt, but this was expensive.

In the article on Gordon's workshop it referred to it being lined by wallboard with a simulated knotty pine planking effect. On investigation, I found this to be not that much more expensive than hardboard, £6 a sheet as opposed to £4 a sheet (2.4m x 1.2m). This is plywood only some 3mm thick, with a layer of paper printed with the knotty pine effect. This may not give the impression of being a suitable material, but the surface appears reasonably oil and scuff resistant. Being made for the purpose I find it remains very flat and looks good when installed. It is also easy to cut with a sharp knife, not at one pass I hasten to add. I accept that it is not that robust, but only time will tell if it stands up to the task. Even if many ideas have been taken from others, there are a number that I have not seen before, and may be original, and that readers may find useful.

Shelving

With the push for more storage, I made the wooden frame of the wall furthest from

the door into the workshop from 160mm x 18mm wood, rather than the more normal 50mm x 35mm. This additional projection into the workshop makes an ideal framework for mounting shelves. The inclusion in each bay of 25mm polystyrene plus the wallboard still leaves 130mm of board projecting to support the shelves. I drilled these uprights, back and front, at a pitch of 50mm over most of their length. By



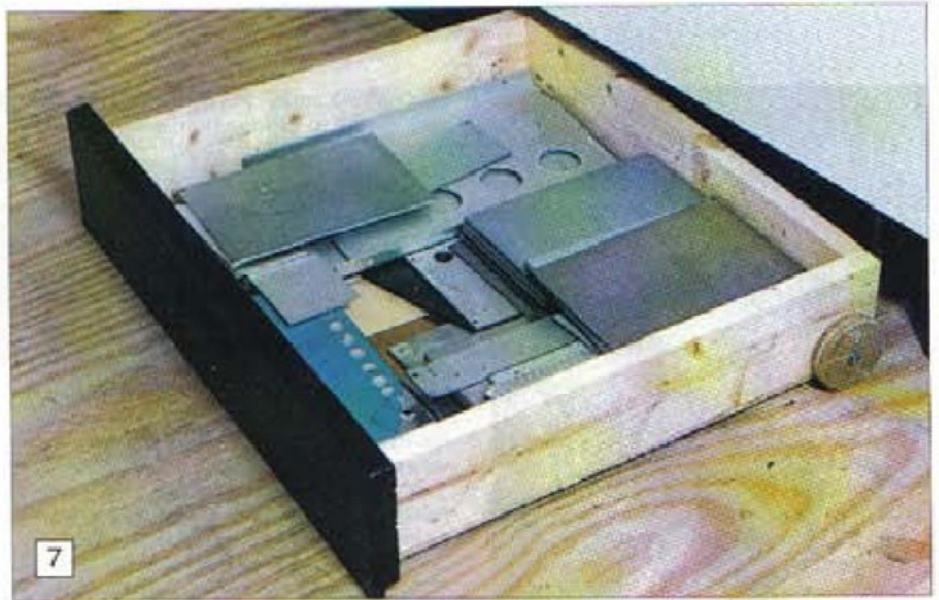
4: The adjustable shelving system shown in close-up.



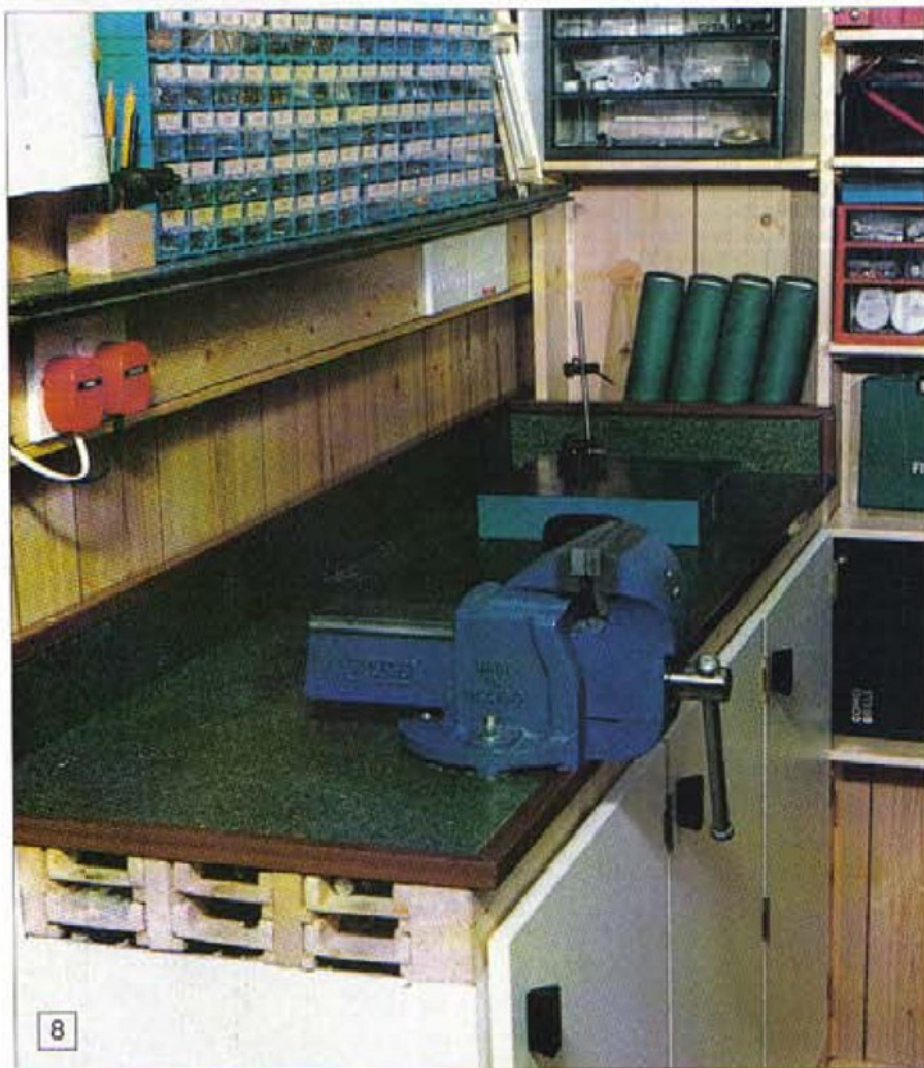
5: The complete shelving facility covers one wall of the workshop. The uprights for the shelves are in fact the frame of the workshop made with wider pieces of wood than is normal.



6: Storage for drawings and the like in postal tubes.



7: Rather than wasting space with a solid plinth, simple drawers have been made. Note the wheels on the rear of the drawer for easy operation of drawers with heavy loads.

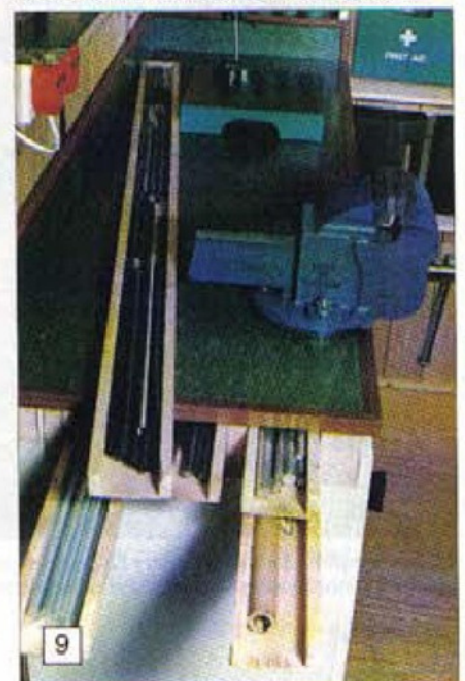


They are therefore ideal for the storage of items such as scraps of sheet metal. This does make them heavy, and because of this, the rear is made to run on simple wheels cut from plywood. This feature is seen in **photograph 7**.

To make the fitting bench as solid as possible the top is supported by a piece of 70 x 44mm at the front edge, and by pieces of 70 x 21mm at intervals front to back. Long thin trays have been made that can slide into these apertures as seen in **photograph 8**. These trays can be used to store the smaller sizes of bar materials, pre wound lengths of spring, studding and the like. These line up with the workshop door, and if they need to be withdrawn completely, (see **photograph 9**), this can be done by opening the door.

With the small plastic storage cabinets now being so cheap, a good supply of these has been obtained for the storage of smaller items. These can be seen in part in **photograph 8**, in all, 12 cabinets each with 16 drawers are available. Items stored in these include smaller screws, nuts etc. up to M5, rivets of various types and DIY items. Larger screws, M6 to M12, are included in the heavier duty cabinet in **photograph 6**.

8 & 9: Long narrow trays have been made for the storage of long items, small size bars, studding, pre wound springs etc..

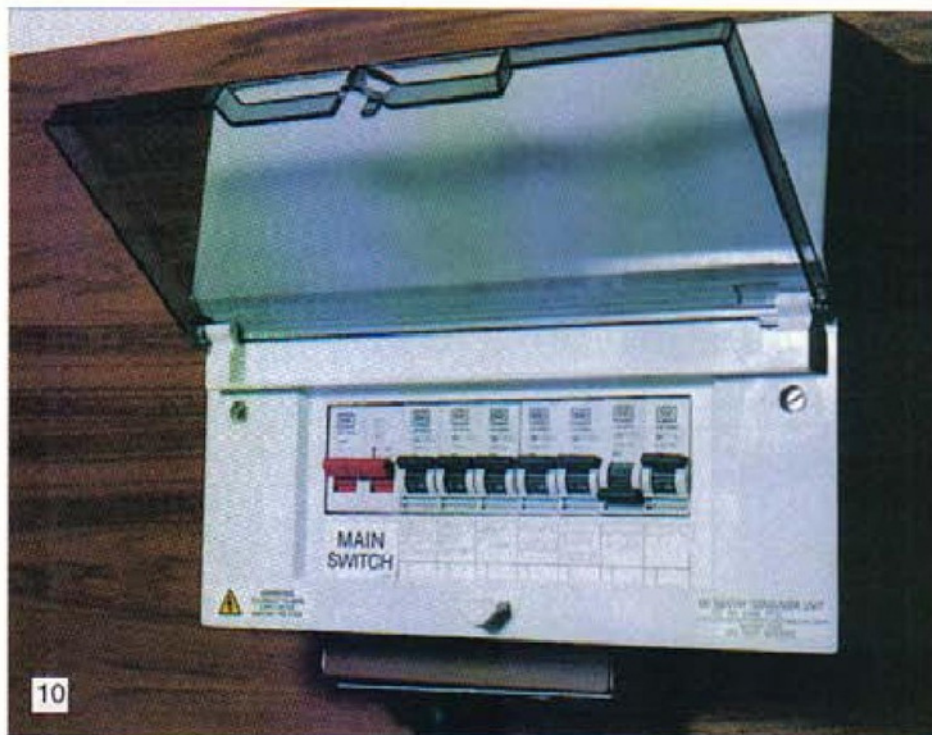


placing lengths of dowel through these holes for the shelves to rest on, positions can be adjusted by the use of the appropriate holes.

The shelves were also made from the 180mm wide material thus making them project out in front of the uprights. To avoid them looking too thick, the front was chamfered on the lower edge. The construction can be seen in close up in **photograph 4**. **Photograph 5** shows the overall effect.

Drawing storage

The wide frame also created an opening, from the top, at that end of each bench. This made an ideal storage compartment for drawings and any other materials able to be rolled that can be stored in postal tubes. **Photograph 6** shows this feature. The space wasted in the normal plinth of a series of cupboards has also been avoided by making drawers at this level. These are butt jointed, and using adhesive, as well as nails, are quite strong.



10: The incoming consumer unit.

The electrics

The electrical installation is worthy of mention, it shares its incoming consumer unit with the adjacent building onto which the workshop is attached, also a remote glasshouse and summer house. The consumer unit, **photograph 10**, is fitted with circuit breakers rather than fuses; these allow the isolation of individual circuits. This particularly beneficial for the remote outlets, where one is more likely to want to isolate them when not being used.

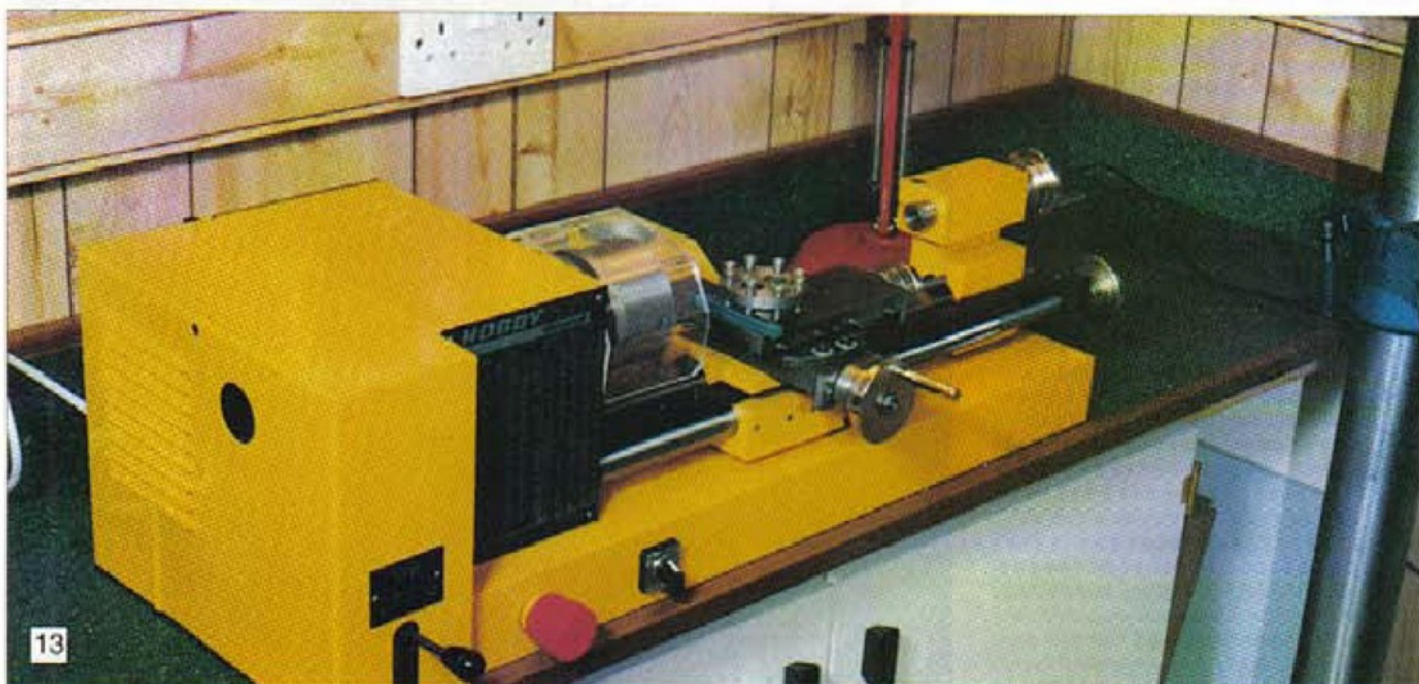
Two ways in the unit are used as above, while a further two are for the adjacent building, this leaves three for the workshop. One is for the lighting, one for the power circuit and the remaining one for heating. The power circuit comprises 10 sockets (5 twins) on a ring main. The heating circuit is a spur that feeds a twin socket enabling an oil filled radiator to be permanently connected for background

heating, and for a fan heater to top up when in residence.

Of greatest interest is the method of running the wires and mounting the various switches, sockets etc.. To achieve this, two lengths of 28mm x 18mm wood were run at the appropriate spacing wherever sockets and switches were required, or cable to be run. Pieces of wood were nailed across these for the fixing of the sockets and switches, and the front face of the strips recessed for including strips of wall board to enclose the cable. The wall board strips were fitted by small patches of impact adhesive, every 100mm or so, this permitted the covers to be easily removed while avoiding the use of nails. The method is best understood by reference to the photographs, particularly **photographs 11 and 12**, before and after the covers are fitted. The very satisfactory outcome of this approach can be seen in many other photographs of the workshop.



11/12: The electrical wiring system, before and after fitting covers over wiring, see also other photos showing this tidy arrangement.



13: The Hobbymat MD65 lathe.



14: The Hobbymat BFE65 milling head with KT coordinate table.



15: The Clarke CP16FP floor mounted drilling machine.

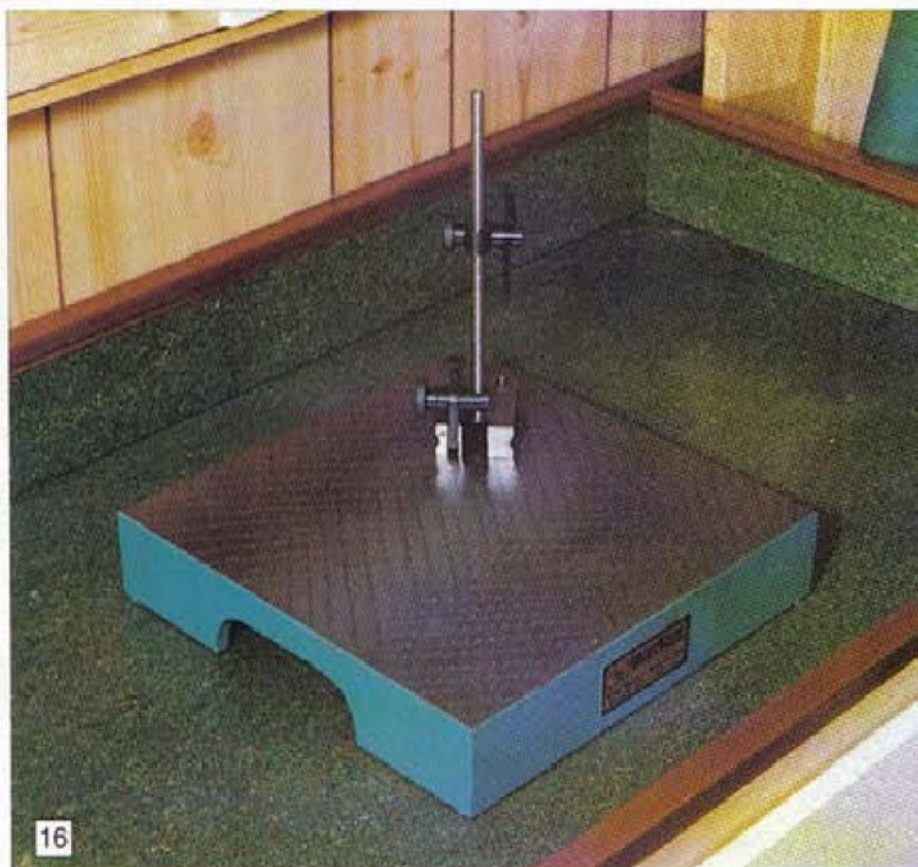
Unit of measure

One decision that would have to be made before proceeding with purchase of machines and tools was what unit of measure I would use as a preference. I say decision, but this was one item where I already had strong feelings towards the use of metric. If I had been given an offer of a secondhand Imperial lathe and milling machine, in new condition and at a good price, perhaps I would have been tempted, fortunately I was not.

The lathe and milling machine

Returning to the question of the machines, how did the site situation finally affect my choice? Well, in view of the less robust nature of the floor than would be ideal, smaller machines seemed the route to take. It was therefore decided that choice was to be a lathe of about 60mm centre height and 350mm plus between centres. Typical examples of these are the smaller Emco lathes, Hobbymat MD65, Minilor TR1. To complement this a vertical milling machine of comparable size. Here there would be such machines as the Rishton Promill 35, and the small machines supplied by Emco and Hobbymat.

Also available, and what looked like very good machines were the lathes and milling machines made by Cowells; these on investigation were considered just too small. Now, it is not my intention in this article to review each of these machines and list all the pros and cons, that I



16: A very nice 250mm x 250mm surface plate available from Chronos.

considered were present. This would make the article too long, anyway, I am not in a position to be sufficiently constructive on the matter. I do not even intend to justify my final selection other than to say that I consider them to achieve a good quality/price ratio, and had some advantages, as well as, no doubt, some disadvantages.

Having decided on a small lathe and complementary sized milling machine, it occurred to me that the machines supplied by Emco and Hobbymat used the same milling head on the small milling machines, as were provided for fitting to the back of the lathe. While it was not intended to carry out milling on the lathe, it was realised that if complimentary machines were obtained from the same manufacturer, this facility could be made use of should the occasion arise. Eventually I settled for the Hobbymat MD6S lathe, **photograph 13**, and their BFE milling head with co-ordinate table, **photograph 14**. The lathe has a centre height of 65mm and a between centres length of 300mm. Its speed range is 250 to 2000 RPM from a motor of 250w output rating. It has a good range of accessories supplied with the machine, in particular the lathe, and many more available as optional extras.

The headstock is bored 12mm, which is quite generous for this size of lathe and has a No.2 Morse taper, it is perhaps unfortunate that the tailstock has only a No. 1 Morse taper.

The mill/drill combination has a head with four speeds, selected by two small levers, no belts to change here, (*latest version now uses belts - Ed.*) from 315 to 1600 rpm and again driven from a 250w motor. It has a quill stroke of 50mm, which means it can be used for drilling, its No. 1 Morse taper means it can use the same drill chuck as the lathe. Fine down feed is with a leadscrew that moves the whole head, up and down the column.

The milling head can also be used with the lathe if this ever proves to be beneficial, and a mounting bracket for this has been obtained, its main use will however be with the coordinate table. This has what I consider to be a generous size table for this type of machine, being 450 x 160mm and having travels of 290 and 140mm.

These items came very well packed, the lathe and the milling head in a purpose made polystyrene package. It really is amazing how strong such packing can be for a material so light in weight. The coordinate table was in a substantial wooden case.

Other machines

The remaining larger items to be purchased were a drilling machine and bench grinder (eventually mounted in another location). The question of the drilling machine was considered from a slightly differing viewpoint. The reason being that it was realised that the cost of a drilling machine was, in terms of the overall cost of the workshop, only a little more expensive for a larger machine than a smaller one.

On this basis, it was considered that a larger machine should be purchased, as this would, to a small extent, overcome a few of the short comings of purchasing a smaller lathe and milling machine. Positioning such a drilling machine would be a problem, due to the overhang of the

motor at the rear, this would require a wide bench on which to be mounted. In such a small workshop an unnecessarily wide bench would be unduly space consuming. It was therefore purchased as a floor standing machine, thus allowing more flexibility as to where it could be positioned. For the drilling machine I chose a Clarke drill supplied by Machine Mart, model number CP16FB, see **photograph 15**. This has a $\frac{3}{4}$ HP motor with 16 speeds from 180 to 2700rpm, 16mm capacity and a No.2 Morse taper. Do not be fooled by the 16 speeds, these are quite unnecessary, what can be gained from speeds of 390,430,450 or 620,650,680, six speeds where two would suffice. Even so, speed was one reason for its choice. The lowest speed of 180rpm was lower than most in its price range. The table size of 305 x 305mm was another plus, as most in its price range had smaller tables, and usually round at that. When I say in its price range, the Clarke was very well priced being the cheapest on the market that I could find. The table pivots to allow for drilling at an angle. I collected the machine from the showrooms already assembled, so I have no idea how it would arrive if purchased mail order.

The grinder obtained is a Black and Decker Professional P7505 with 150mm wheels. This has a 250w, permanent capacitor, (i.e. no centrifugal switch) single phase induction motor that runs very sweetly at around 3000 rpm. I think it is the equal of some supplied under other brand names.

Hand tools

A wide range of small tools would have to be purchased and these also would be metric where appropriate. I soon realised that while not costing great amounts individually, *en masse* these were going to account for a tidy sum. Because of this I decided to go for the minimum purchase mostly and to expand only as I was confident that the purchase was absolutely necessary.

Measuring

The first instance of this was with measuring equipment, I would like to obtain two micrometers 0-25mm and 25-50mm plus a 150mm hand vernier, but in the interests of economy the 25-50mm micrometer would be put on hold.

I would like a small sized surface plate, new would be nice, but probably more expensive than could be justified. Even so I considered that either new or second hand was going to be difficult to find in the size I had in mind, say 250mm x 250mm. A sheet of glass looked like the way out.

Cutting tools

Again the choice of metric would affect the choice of items obtained in this category. Having decided on a drill with a capacity of at least 12mm two sets of drills would be required, I decided on 1-6mm and 6 - 10mm both in 0.1mm increments. Having now gone down that road, the 6 to 10mm in 0.1mm steps is a little extravagant. To have purchased individually from 6 to 12mm in 0.5mm steps would have been a better buy, plus any sizes in between that would be required for such applications as tapping. The drill sets I purchased were British

made by Dormer, these advertised in *Model Engineer* by Mill Hill Supplies from time to time at advantageous prices.

Taps and dies would again be metric and M3, M4, M5, M6 and M8 sizes were chosen. As a compromise to my metric intention, I considered that I would like some of the finer thread ME sizes, perhaps $\frac{1}{16}$ in. x 40TPI, $\frac{1}{8}$ in. x 40TPI and $\frac{1}{4}$ in. x 32 TPI as these fine threads would be preferable when perhaps I made some toolmakers clamps, typical of the items I expect to be making in the early days of my workshop. Reamers were another item put on hold, perhaps a series of D bits made to metric dimensions could be another early project.

Small tools

While the workshop was largely started from scratch a range of small tools, pliers, spanners etc. were available and any shortcomings in this direction will be eliminated as they became apparent.

Purchase of smaller items

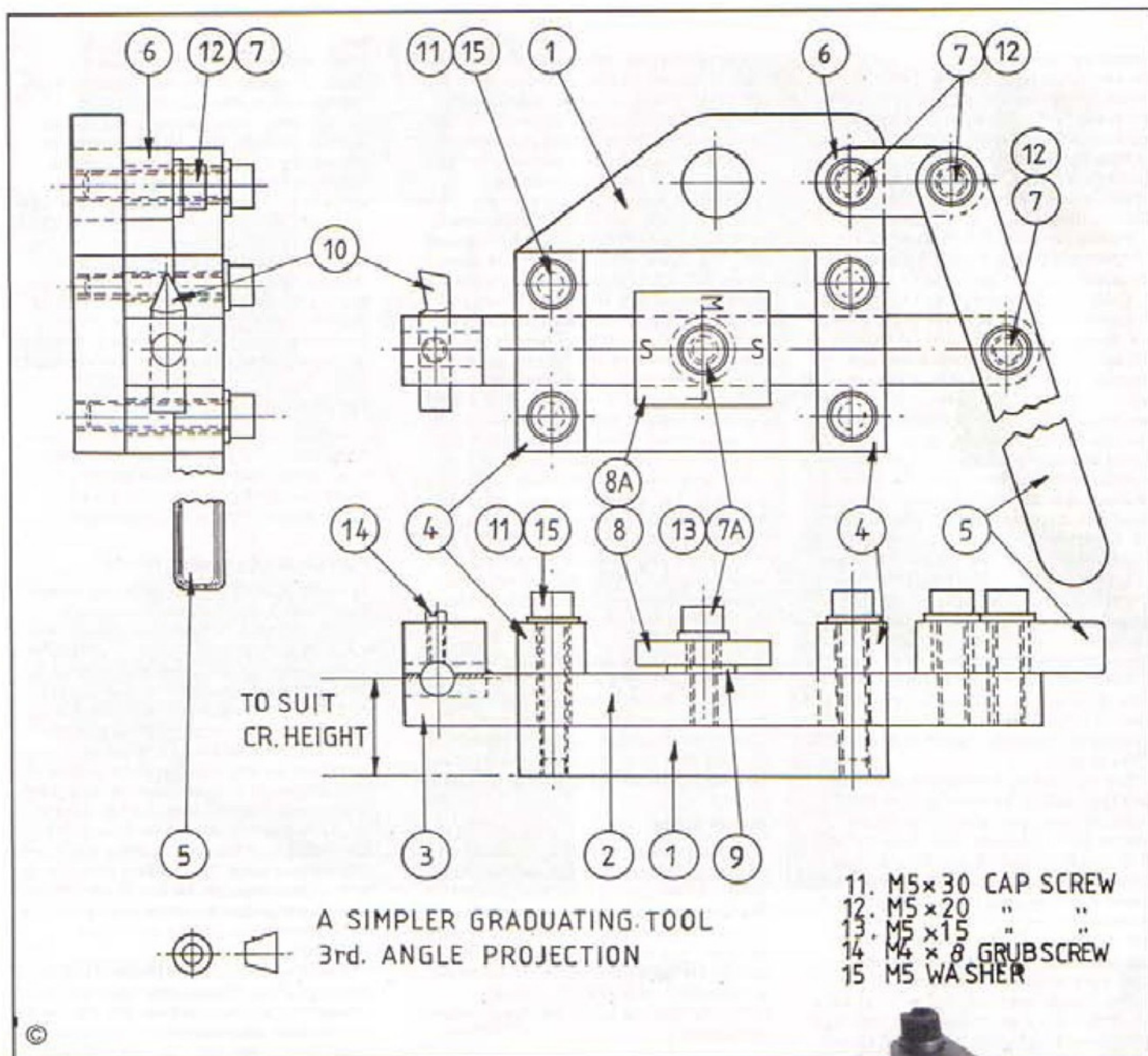
I will not go into great detail regarding the smaller items but perhaps two are worthy of mention. Firstly, the decision to make do with a piece of glass in place of a genuine surface plate, was changed when finding in the Chronos catalogue a small cast iron surface plate 250 x 250mm. Finding this one, I scoured the pages of other suppliers without finding any comparable item, it seems to be unique in the home workshop suppliers area. It was rather more expensive than I had wanted to pay, but on the other hand less than I had anticipated for such an item. It is a very nice surface plate. This surface plate can be seen in **photograph 16** which also shown a smaller than usual surface gauge that complements the surface plate, this supplied by Tilgear.

The other item worthy of comment is the bench vice. Having seen the wide range of economy vices, (machine, drilling, bench etc.) on offer when visiting the various exhibitions, I had come to the conclusion that these mostly range from the poor to the very poor. Because of this I decided to purchase one of reputable make, and a 4 in. vice made by Record was chosen. This again was purchased from Machine Mart, and while much more pricey than its competition I have no doubt that, having now installed it, I will have no regrets regarding its choice. It is a very substantial and well made vice.

A final comment

I realise that there will be few readers who will be in a position to create a brand new workshop, the cost alone, even for the small machines, is not inconsiderable, but hopefully there will have been some comment or idea that has proved useful. Failing that, then perhaps the article has provided an hour or so of interesting reading while the lure of the workshop was perhaps not that overpowering.

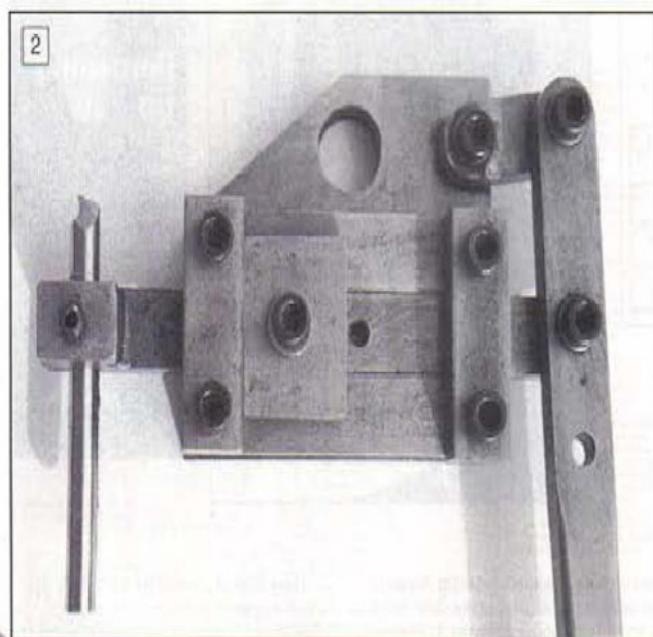
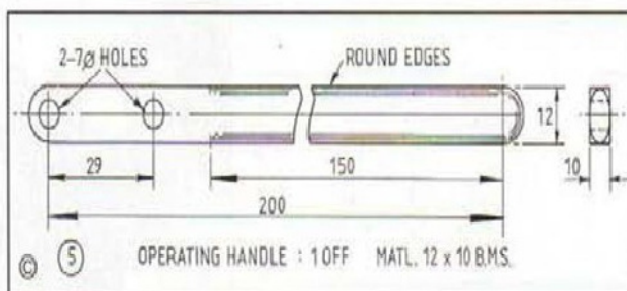
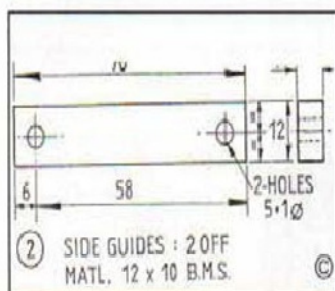
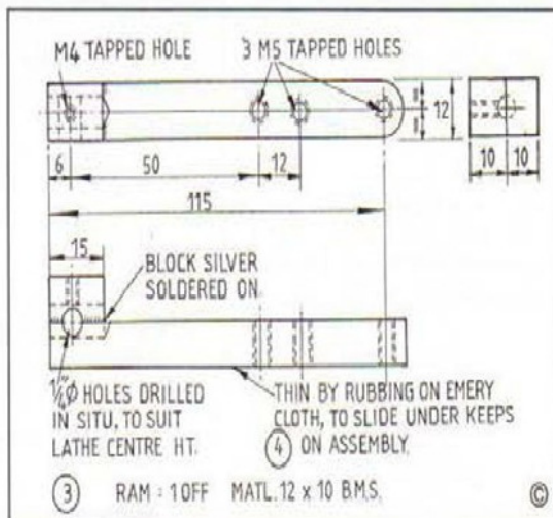
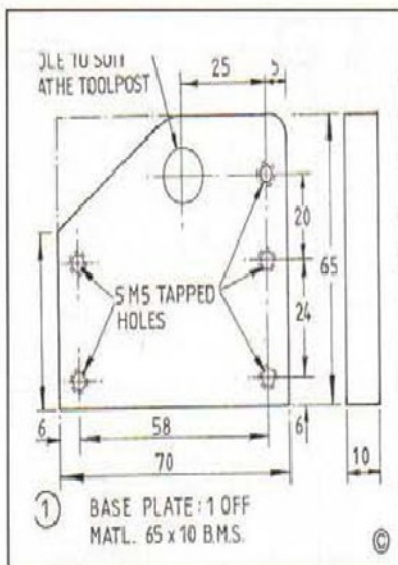
Probably of more potential, is that as I expand the capability of the workshop by my own efforts, some of the items I make will perhaps provide material for some interesting constructional articles. These may then also find their way into *M.E.W.* at a later date. Perhaps after all that I just may manage to try my hand at a small model or two.



If you ever have a need to graduate leadscrew dials or similar, it is probable that it will only be an occasional requirement. In this article, the author, R.W. Buck, suggests a design which he considers adequate for the limited use it is likely to receive. Also, being simple it will not be unnecessarily time consuming to construct. Despite its simple design, it still has the facility for ensuring three consistent line lengths, normally a requirement on these types of dials.



A SIMPLER GRADUATING TOOL



1: A general view of the completed tool.

2: Looking down on the tool shows the simple construction used by the Author.

There have been a number of excellent designs published in *M.E.* for Graduation Marking Tools of varying complexity, but it seemed to me that while dovetail slides, counting mechanisms, and dissimilar sliding metal surfaces are very correct, for the amount of working life this device would have, they are a luxury and a simpler type of tool should be a possibility.

First of all, how many index dials would I be likely to require? Listing them, in my case, the total was 10, made up as follows:

Rebuilt ML4 Lathe	3
Vertical slide	1
Vertical Milling Machine	3
4in. Lathe - under construction (slowly)	3
Total	10

Systematic storage

If you use small tins for the storage of small parts, colour code them for identification of contents, say, yellow for springs, blue for washers etc. Then add in words such comments as large, medium, small, cap head, countersunk etc. This will save much time in sorting through a pile of tins all the same flavour, so to speak.

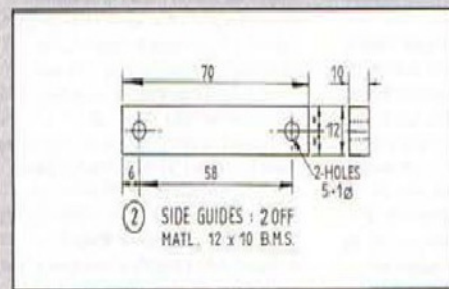
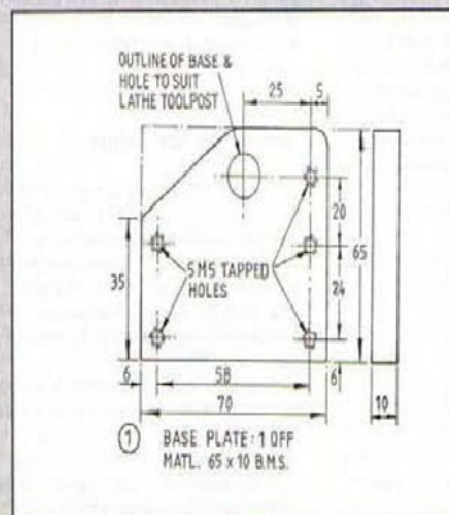
K.J. McLaughlin

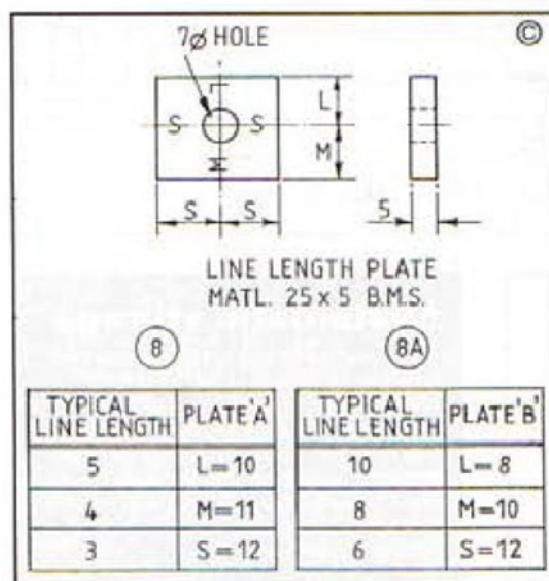
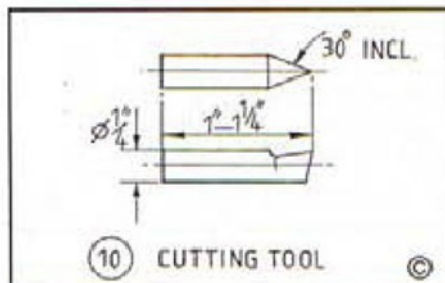
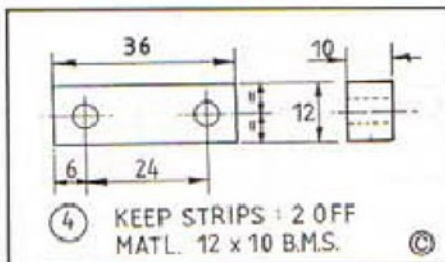
There would also be some graduations on the topsides of the lathes and on the base of a gear cutting attachment some time in the future. The total number of strokes would be in the region of 3000 so I decided that MS against MS sliding surfaces would be satisfactory. A spell of thinking followed and after a few sketches the tool shown in the accompanying drawing was devised, using BMS sections screwed together on a suitable baseplate. I used cap screws for assembly because I had a stock of them and, for simplicity in construction, did not counterbore for the heads. The tool can be used to cut from right to left, or from left to right, using the clamping straps as stops and the alternative line-length plate positions. The photos show the complete tool and a collar graduated with it.

The baseplate, shaped to suit, can be clamped on the top slide tool post bolt, in the tool turret or on a packing block on the cross slide, as long as the tool-bit hole is drilled at centre height. The plate can be faced or filed flat, smoothed on emery cloth, or the height of luxury, surface ground. The sliding ram needs thinning a thou or two to slide under the clamping

A Simple Graduating Tool - correction

The gremlins got in at the printing stage of page 55 issue 24 and, as a result, two drawings had data trimmed from their edges. There was also an error in the hole centres of the Side Guides (2). The drawings are republished herewith, this being the easiest way to convey the requirements. Please, if you hold a collection of issues of *MEW* take the trouble to mark up the drawings in issue 24 referring them to this issue.



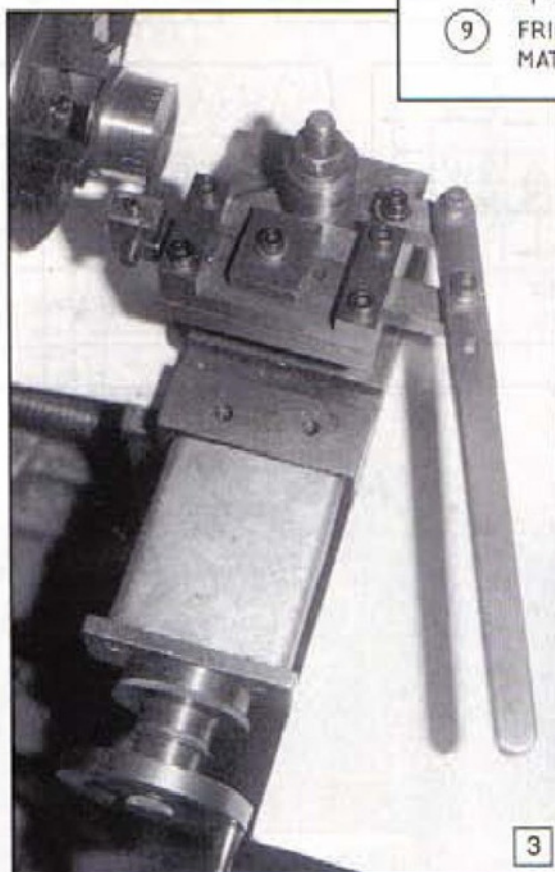
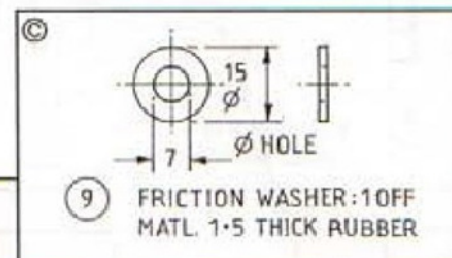
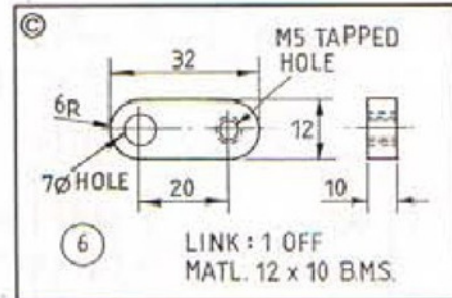
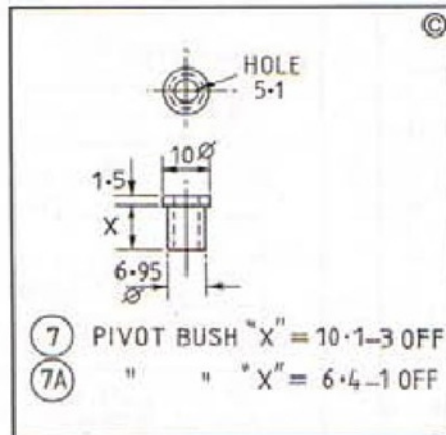


4: The results of the work, a successfully completed index dial mounted on the cross slide of the Author's lathe.

strips. The guide strips are simply squeezed against the ram and the screws tightened. Wear, if any ever occurs, can be countered by loosening two of the screws, squeezing the guide strip against the ram and retightening the screws.

For varying the index line lengths, there is a rectangular plate with an offset pivot hole, marked as shown and clamped by a shorter pivot bush, with a rubber friction washer underneath the plate. Alternative plates are shown giving two sets of line lengths, but these can be arranged to suit individual requirements.

To use the tool, set it on the lathe as



3: The tool mounted on the lathe and being used to incise an embryo dial.

Hardening tip

During the hardening of small components with holes in, the risk of cracking at the holes during quenching can be reduced by plugging them with tapered mild steel plugs which are a tight fit.

Alan Jeeves

preferred, fit a suitable Indexing device to the lathe mandrel and put the collar to be indexed in the chuck. With the 'L' position of the plate against the appropriate stop, set the saddle to ensure the longest line length is correct and lock the saddle. Set the cross slide to give a 4 to 5 thou. cut and cut the long line. Withdraw the tool ram, turn the plate clockwise to 'S', index the collar around and cut the first short line. Repeat the tool withdrawal, indexing and cutting until 4 short lines are cut, then turn the plate to 'M' and cut the medium line. Withdraw the tool and turn the plate to 'L' and repeat to cut the 10th line. Continue this sequence until all the graduations are cut.

The counting couldn't be easier. It is simply:

- 1 - 'L' line
 - 4 - 'S' lines
 - 1 - 'M' line
 - 4 - 'S' lines
- repeating until graduating is complete.

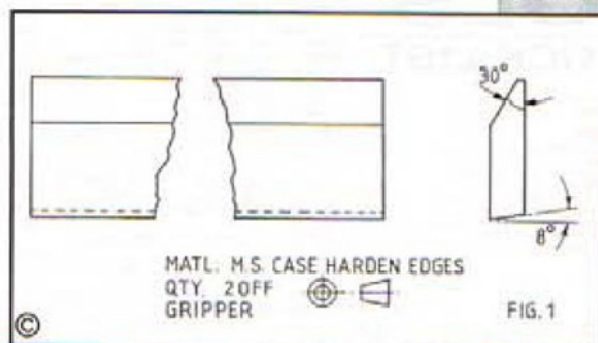
Have a bit of practice on a bit of bar. It is much quicker and easier to do than describe.

The cutting tool can be mounted to either side of the ram, and in addition a suitable tool can be mounted in the end to cut keyways, splines, etc. in flywheels, timing gears, or cams for small steam or I.C. engines.

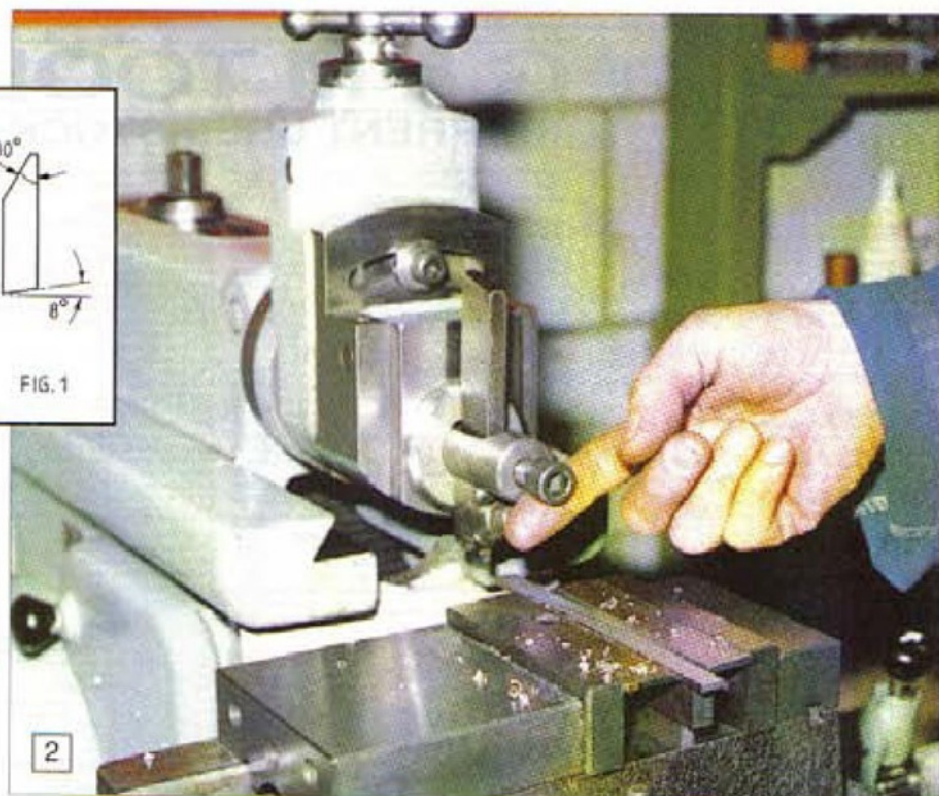
It also occurs to me that a more substantial version could be made using a 25mm or 30mm square ram, for cutting bigger and longer keyways or splines.

I hope that some readers may find my version of a graduating tool of interest, and agree with me that it is practical and does the job without taking a lot of valuable time to construct.

(Instead of thinning one piece a strip of paper could be inserted between components 4 and 2 on each corner - this should have the desired effect. - Ed.)



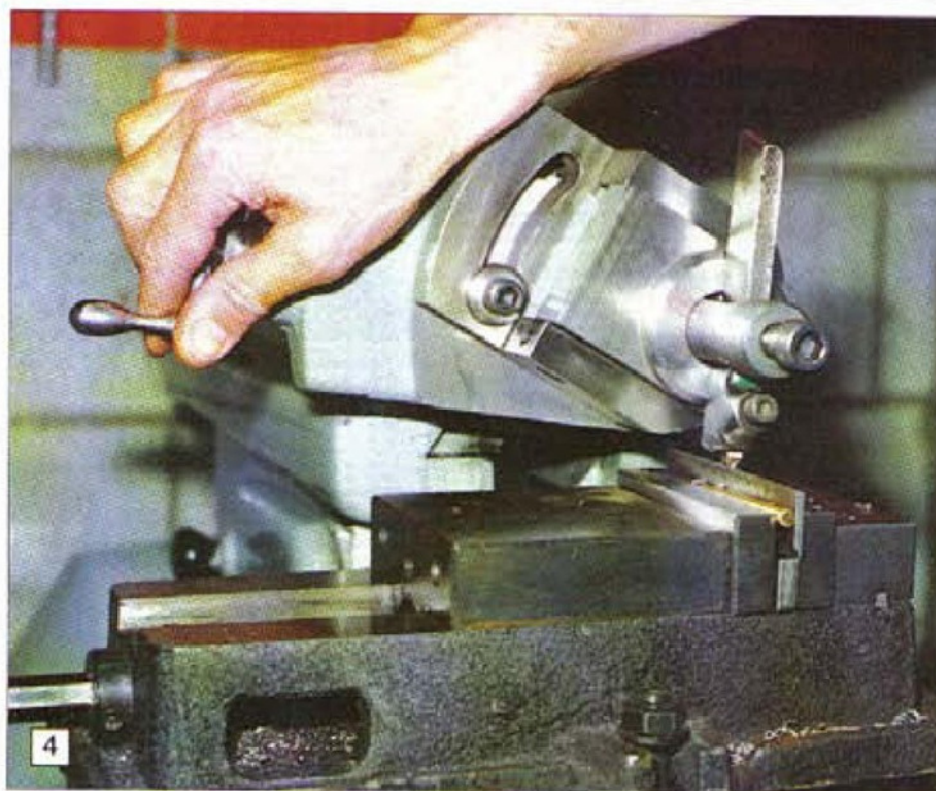
Bill Morris, of New Zealand, continues his series on the shaping machine, with some practical instructions as to its usage. He takes the opportunity of describing the machining of his design for a very nice vertical slide



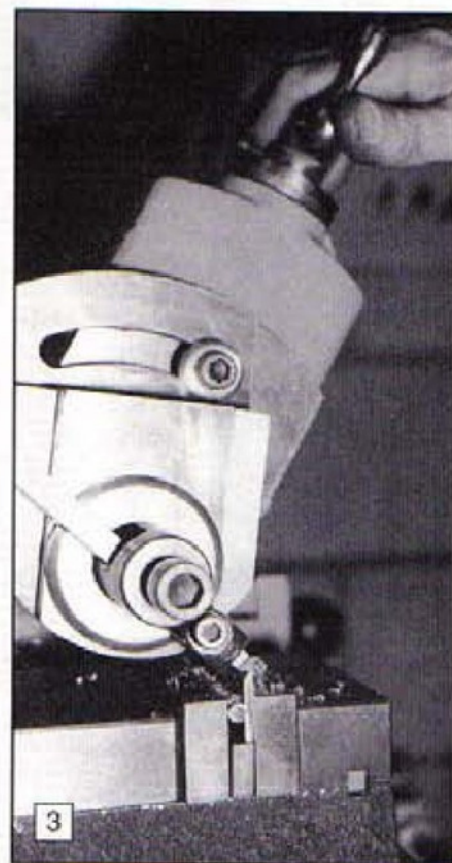
2: The gripper in use.

MORE STROKES WITH A SHAPER

PART 2



4: Machining 82 deg. bevel on gripper.



3: Machining 30 deg. bevel on gripper.

Making a pair of grippers (Fig.1) is a good shaping exercise to start with as you end up with something that is immediately useful. These simple devices are invaluable for holding thin workpieces hard down on to parallels in the machine vice (Fig.2).

Set a piece of 3 x 25mm bar edge up on a parallel in the vice and true up the edge, taking a fine cut at fine feed. The tool is shaped like a left hand lathe finishing tool to get the best possible finish. Then set over the tool slide by 30 deg. to produce the bevel by feeding the tool slide down

about 0.05mm per stroke and applying cut with the cross slide (**Fig. 3**). Reverse edge for edge in the vice and set over the tool slide by 82 deg. to produce the very steep bevel on the other edge in the same way (**Fig. 4**). Do the same thing with another piece, case harden the edges if you wish and you have a pair of grippers. At first you will find you need four hands to wangle them into position but with practice, two hands will do the trick.

A larger task

In thinking of the best way to illustrate the versatility of the shaper I thought I would construct a vertical slide for a friend and, although I have a mill-drill, I decided to make another one for myself as part of a dividing set-up.

Although wood is not kind to me, I can manage to make patterns out of high density chipboard and for relatively small castings the local foundry seems to manage very well when my patterns don't have any "draw" at all. However, I do take care to include large fillets and to make sure that the surfaces of the patterns are smooth. The manager of Milson Foundry in Palmerston North, New Zealand, seems always happy to oblige the amateur and produces clean castings free of hard spots and holes.



5: Base casting clamped to angle plate and thence to machine table.

Within a week of taking in my amateurish patterns I was able to collect two pairs of vertical slide castings for a total cost of just under NZ\$60 (about £20).

Workholding in the shaper does not differ in its essentials from workholding in the milling machine except that one has to be aware of the repetitive shock loading that occurs with the shaper. Occasionally stops are needed, especially if there are any doubts about the security of the set-up. **Figure 5** shows the base casting clamped to a large angle plate after cleaning off minor lumps with an old file. Interpose a sheet of paper between the casting and the angle plate to improve grip and protect the angle plate's surface.

The tool in use is a carbide tipped left hand knife tool to remove the skin of the casting. In other respects it is rather like a typical lathe tool and it is left handed simply because the feed and clutch controls are on the right of the shaper. If you have the feed towards you it is easier to see the surface being generated. Although carbide tools do not like intermittent cuts and chatter will rapidly destroy the cutting edge, they seem

quite happy with the relatively gentle engagement of cut in the shaping machine.

Once the work is set-up securely on the table the clapper box can be set in a neutral position and the tool slide positioned so that there is a minimum of overhang and a maximum area of the sliding surfaces in contact with each other. It is best to keep the gib screws a little on the tight side; I also keep the locking screw finger tight when making adjustments so that the feed screw works against some resistance rather than slipping and sticking uncertainly as it moves down with help from gravity. Then wind up the table, until by eyeballing the job you can see that with a little feed on the tool slide a cut can be taken. At this point tighten up the table support. If it is a peg leg type, as on my machine, apply a firm downward pressure to it to counteract any tendency for the leg to lift up slightly when tightening the locking bolt. The length of stroke is set to be about 50mm longer than the workpiece. The ram is wound fully backwards by pulling the pulley wheel round with the clutch engaged, so that the starting position of the ram can be set about 20mm behind the workpiece. Pull the ram through a full cycle by hand to check that the tool will clear the work at both ends and disengage the clutch. Now you can switch on, engage the clutch and feed the tool down until it cuts through the skin of the casting. Then lock the tool slide as the vibration from the intermittent cut and the tool angle will otherwise tend to put on feed. Wind the work away from you, and the tool using the cross feed handle, start the ram and engage the feed ratchet, three or four clicks (about 0.3 to 0.4 mm) per stroke for this roughing cut, and sit down to watch the machine do all the hard work. Make sure the feed takes place on the return stroke.

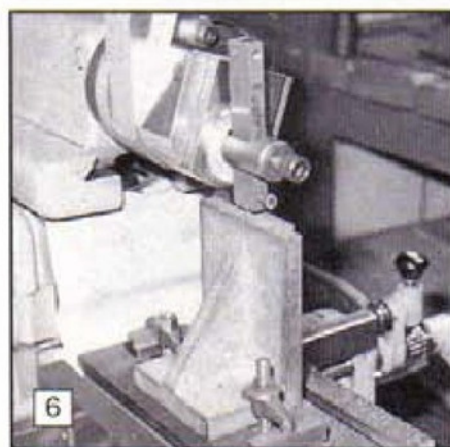
The correct speed and safety factors

For the amateur, the correct stroke speed is that which does the job without chatter or too much vibration. Remember that the peak tool speed will be greater for long strokes than for short. As it is so easy to start and stop the ram with the clutch, there really is no excuse for not stopping the ram to lock or adjust the slide. Cultivate the habit of removing the handle from the cross feed shaft once you have brought the work up to the cut, or sooner or later it will drop off the shaper on to your foot! Worse, when using coarse feed, it can move through a quarter turn in a very rapid jump and the clearance between the handle and the vertical feed shaft is very much less than the thickness of a finger. If your finger happens to be around when the two are passing each other, the machine won't even hesitate as it removes the obstruction.

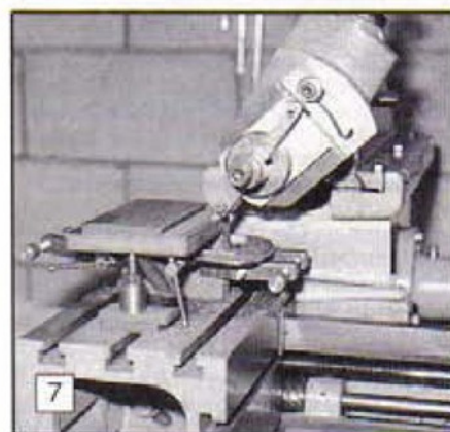
Moving on

Fig. 6 shows a possible next step with the base clamped to the shaper table to rough machine the top edge for marking out the dovetail. Here you can see a home made double ended tool holder that uses 1/2 in. square tool bits; I have made it of the largest section that the tool post will accommodate for maximum rigidity.

For shaper tools, 3 or 4 deg. of front and side clearance angle and a positive rake of 2 deg. work well with cast iron while giving maximum robustness for the cutting edge



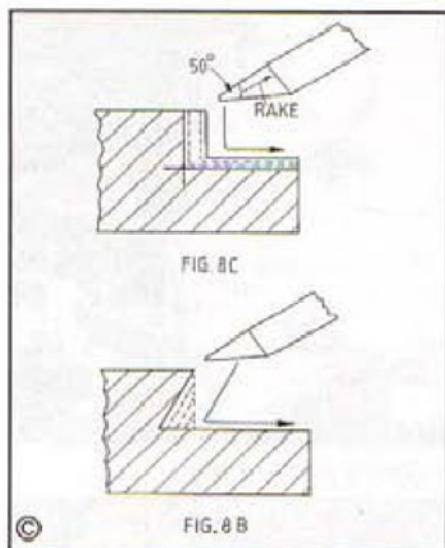
6: Cleaning up top of base.



7: Roughing out dovetail.

to withstand the intermittent cut. For steel a positive rake of about 15 deg. cuts freely. Just as for lathe tools, good finish depends in part on the tool being sharp with the tip of the tool being radiused and its top honed to a smooth surface so that the chip flows smoothly over it. In this picture (**Fig. 7**) the tool box has been rotated clockwise so that in theory at least, the tool swings up over the previously machined surface on the return stroke instead of dragging over the unmachined surface when the box is in the neutral position. In practice, with a low cutting speed at the former setting, the tool tends to bounce gently over the freshly machined surface leaving two or three little pits. While seldom of any practical importance, they do tend to spoil the appearance of the finished work. When taking a finishing cut when appearance is very important, the tool can be lifted off the work by hand on the return stroke.

Figure 7 shows one possible set-up for machining the dovetail with the base clamped to an angle plate and support given by a small jack to the overhanging end. Despite the four clamps and the very substantial web on the casting, there was nevertheless a tendency for the end to flex, so to machine the second set of castings and finish the first I reversed the set-up end for end and used a much bigger angle plate as shown in **Fig. 10**. This way, everything was in compression on the cutting stroke. The only marking out needed for the dovetail is to show the outside corners and bottom. The tool is then fed vertically downwards by hand with the tool slide and outwards from the corner in a series of cuts until you reach the marked lines (**Fig. 8a**). Remember to rotate the tool box clockwise



for the right hand corner and anticlockwise for the left hand corner so that the tool swings away from the vertical surface and up from the horizontal surface on the return stroke.

To return to **Fig. 7**, the tool slide is then set over to 30 degrees. Ideally, this should be set with a Vernier protractor or a clinometer, but only the fortunate few will have these and in practice, it is sufficient to use the tool slide's angular graduations, setting it carefully with the aid of a hand lens. The tool has an included angle of 50deg. so that there is clearance on the side and bottom of the dovetail. For cast iron it needs no rake; for steel it would have a rake in the direction shown in **Fig. 8**.

The tool is wound down until it scrapes the bottom and the index set to zero. It is then brought up again about a millimetre and the table wound across until the tool just scrapes the vertical face. Feed is then applied with the tool slide, about 0.1mm per stroke, to form the sloping side of the dovetail until the index again reads zero. It is wound up until the point is a further millimetre higher, the table wound across and another slice taken off using the tool slide until the side of the dovetail is fully formed (**Fig. 8b**). On the last slice, the tool slide is wound down just a little beyond the zero and a finishing cut applied to the bottom of the dovetail by traversing the table so that the tool feeds outwards, just



9: Setting datum for second side of dovetail.



10: Checking dovetail for parallelism.

as when roughing out. Taking the cut in this direction gives a better finish than when feeding in because the tool is taking a broad fine cut. In cast iron, it is almost impossible to see the tool marks so fine is the finish. Again, remember to rotate the clapper box in the correct direction (clockwise for the right hand side) or something unfortunate may happen...

The clapper box is then rotated anti-clockwise, the tool slide rotated 30 deg. in the opposite direction and the tool bit replaced by one of the opposite hand to do the other side of the dovetail. It is important that the flats of the dovetail should be in the same plane and **Fig. 9** shows one way of achieving this by nipping a feeler blade between the surface just machined and the tip of the tool.

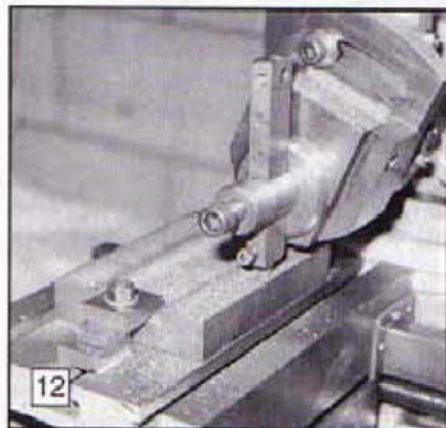
The tool slide is then wound down for the thickness of the feeler blade times 1.15, ($1/\cos. 30\text{deg.} - \text{Ed.}$), the tool slide index set to zero and the final cut taken at this setting on the second side. This is the text book way, but I find it just as easy to set the tool slide to zero when the tool just kisses the machined surface. It leaves a very faint mark which is of no practical importance.

Checking for parallelism

After finishing the dovetail to size, it pays to check that the angular sides are parallel to each other by measuring across two short pieces of silver steel at each end (**Fig. 10**). If the ram is loose in its ways or is worn, you may find that the outboard end of the dovetail is wider than the inboard end, in which case your new slide won't work properly as the gib strip cannot compensate for this fault. It was a fault of this type that led me to dismantle the ram of my machine to examine it and its ways for wear. The original scraper marks were visible on the ways of the body so there was plainly little wear there, but the gib strip was worn in the centre and the under surface of the ram worn at the front end. Surprisingly, and to my relief, there was no detectable out of flatness of the angular sides of the ram. I spent two laborious



11: Set-up for machining edge of table.



12: Set-up for roughing underside of table.

evenings with a scraper getting things flat again and on re-machining the dovetail found the sides parallel to less than 0.02mm in 140 mm. Cleaning up the edges is quite straightforward, using clamping set-ups similar to those in **Figure 7**. It is worthwhile to take care that edges as well as surfaces are square to each other, as this makes setting up of the vertical slide on the lathe much easier.

Now make a start on the table by cleaning off bumps with a file and clamping it to an angle plate with one edge



13: Setting vice jaws parallel to ram movement.

supported on a parallel (Fig. 11). This gives a secure set-up for machining one edge and it is then turned around to do the other edge before clamping it directly to the table of the shaper to rough machine the underside (Fig. 12).

With the two edges now parallel and the bottom approximately at right angles to them, a machine vice can be set-up on the shaper table with its jaws set parallel to the stroke of the ram (Fig. 13). The slide table is then set down on to a pair of parallels for the rough machining of the top surface (Fig. 14). If the vice is in good condition and the parallels really are parallel and equal in height, there should be no need to hammer the work hard down on to them and certainly no need to use a hammer on the vice handle. The routine should be a firm, steadily increasing pressure on the vice handle, a brisk tap on the work over each end of each parallel, followed by a check that each end is held by the work and a final nip of the vice.

Security problems

If one edge of the workpiece keeps lifting in the vice, perhaps because the edge is not

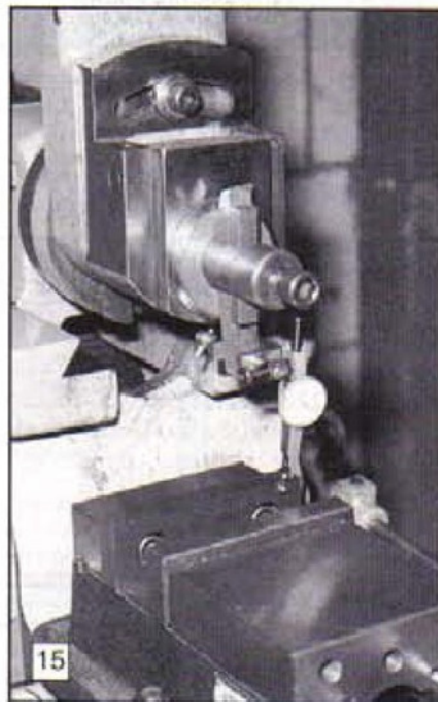
truly square to the under surface of the workpiece, try rotating it edge for edge in the vice. If this does not work, a piece of paper folded twice into a narrow spill about 5mm wide and interposed between the moving jaw and the workpiece may bring about a cure. Some workers favour interposing a thin round bar; this tends to mark the work.

After machining, the table is turned over in the vice and the dovetail machined roughly to size. The process is essentially similar to that for cutting the dovetail on the body except that the finish on the side that is to have the gib strip is unimportant, nor does it matter whether the "roof" of the dovetail is exactly the same height on each side since this is an air fit. However, when the dovetail is finish machined, the two flats on the underside of the table must be both well finished and in the same plane as each other. The ends of the table can be finished at this stage by rotating the vice through 90deg. and taking a vertical cut with the tool slide set vertical, but to ensure that the end is square both to the top and the edges so that the feed screw does not bind means that both the vice and the tool slide have to be set accurately with a D.T.I. It is far easier to leave the ends to last and finish them by clamping the table to a large angle plate, setting one edge square to the shaper table.

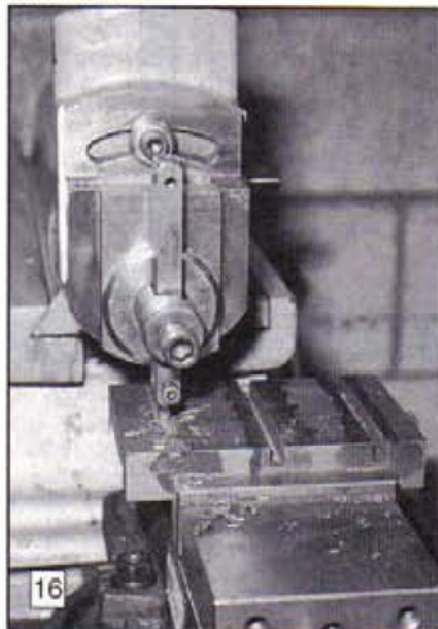
Shaping the tee slots

You can now mark out for the tee slots. If you mark out the section of the slots on both sides of the slide, you can get away with using only one tee slot tool, instead of one of either hand. Since there is much more work in making a tool than in the extra marking out, I am all for saving labour. Having done this, rotate the vice and set it so that the jaws are parallel to the cross movement of the shaper table (Fig. 15). Set the table down on to parallels and you are ready to start on the most challenging and nerve-racking process in using a shaping machine, that of cutting tee slots.

Start by putting a stout slotting tool in the tool holder. It is of the same general

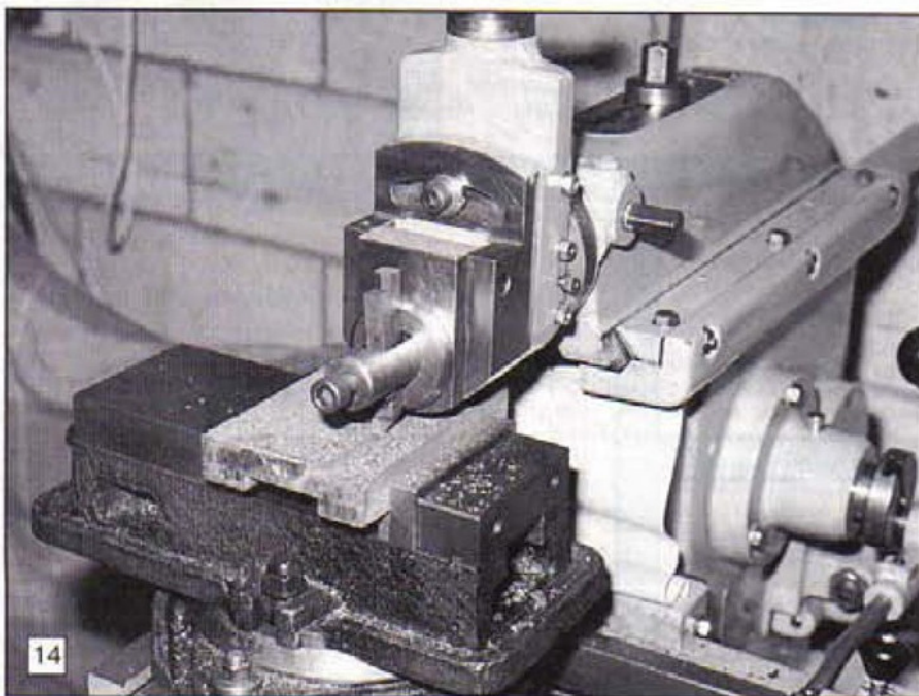


15: Setting vice jaws parallel to cross slide movement.



16: Slotting the table.

form as a lathe parting tool, with, for cast iron, about 4deg. front clearance, 2deg. side clearance, 2deg. back clearance and 2deg. rake. It must be long enough to reach the bottom of the tee slot. The clapper box must be set to a strictly neutral position or the tool will scrape, tear or jam against the sides on the return stroke. It is then a matter of feeding it down in easy stages on the backstroke to the full depth of the slot and cleaning up each edge to split the fine centre pops that mark the outline (Fig. 16). You now have to make a tee slot cutter like that drawn in Fig. 17. It has clearances all round which necessarily weaken it and it has a lot of heavy cuts to contend with, so make it of the deepest section that your tool post will accommodate. I used a scrap of 25 x 12mm gauge plate fashioned with a file and then hardened and tempered. At a pinch, case hardened mild steel could be used. The stroke should now be set to the maximum with roughly equal clearances front and back and the speed set to the minimum, for reasons that are about to become clear.



14: Set-up for roughing top of vertical slide table.

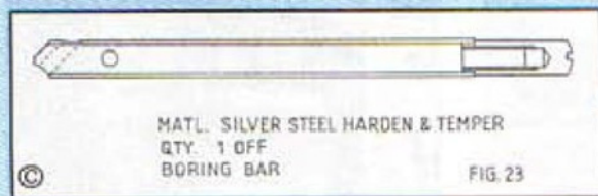


FIG. 23

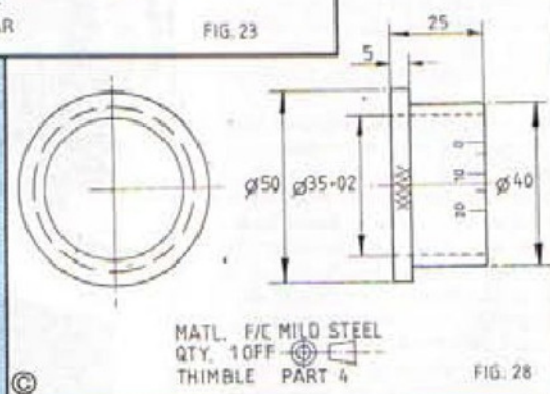


FIG. 28

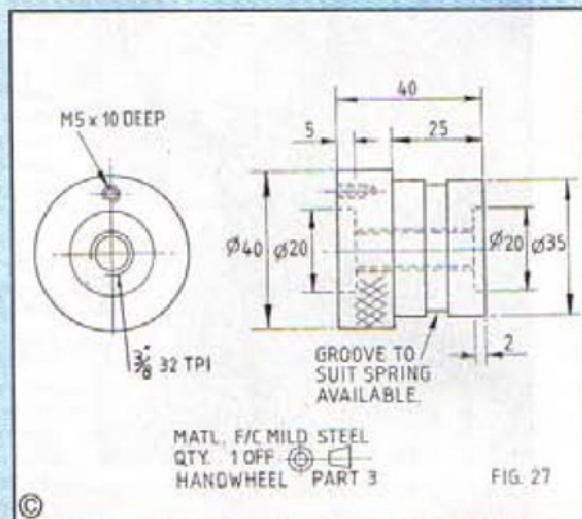


FIG. 27

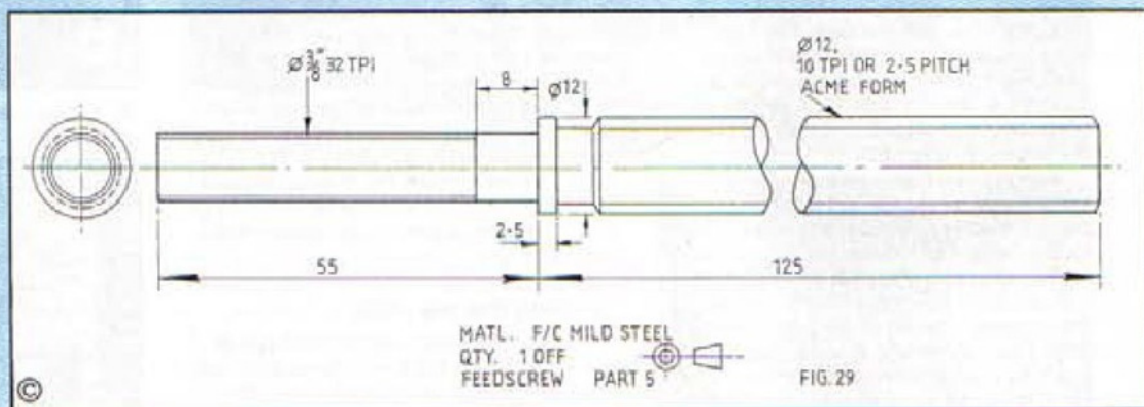
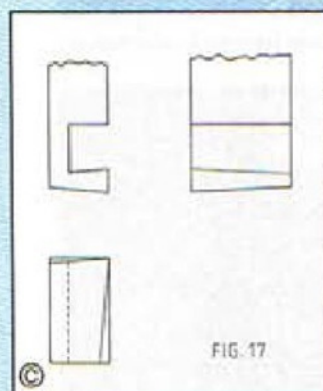
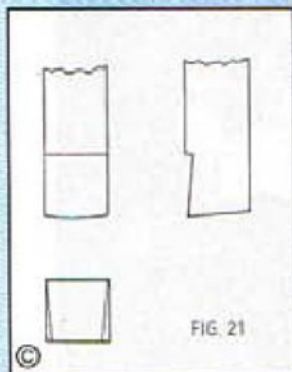


FIG. 29

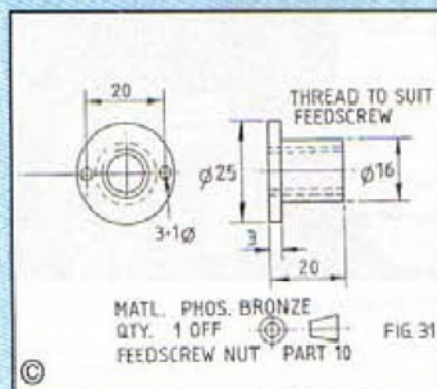


FIG. 31

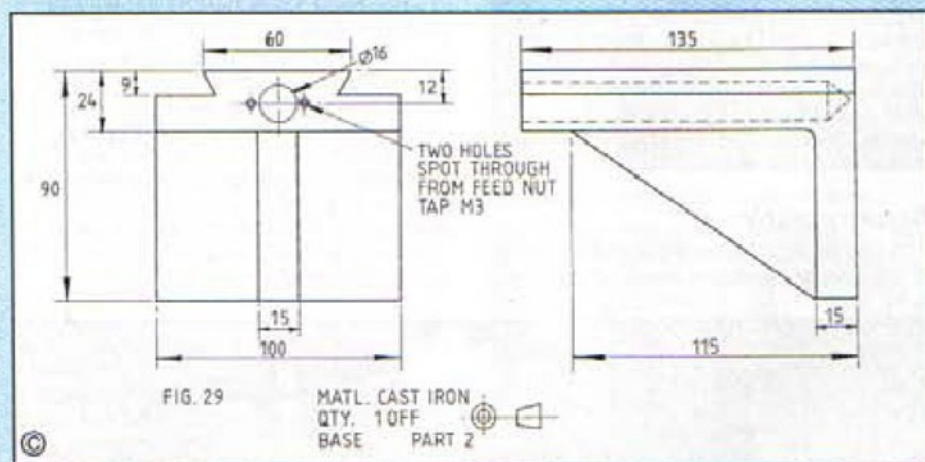


FIG. 29

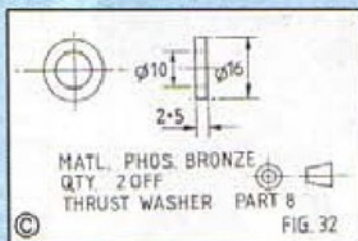
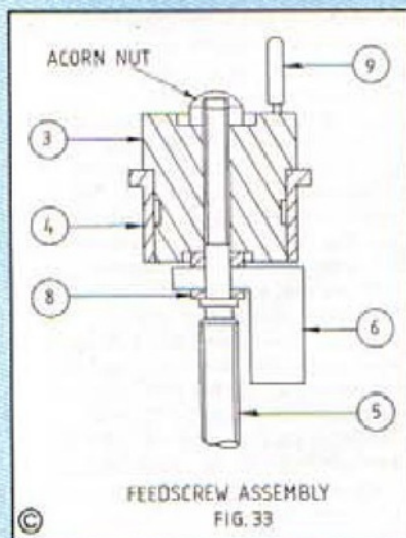


FIG. 32

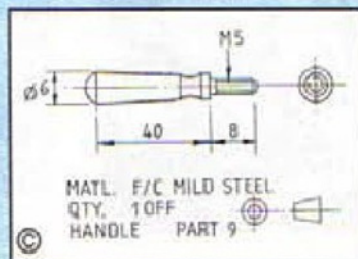


FIG. 30

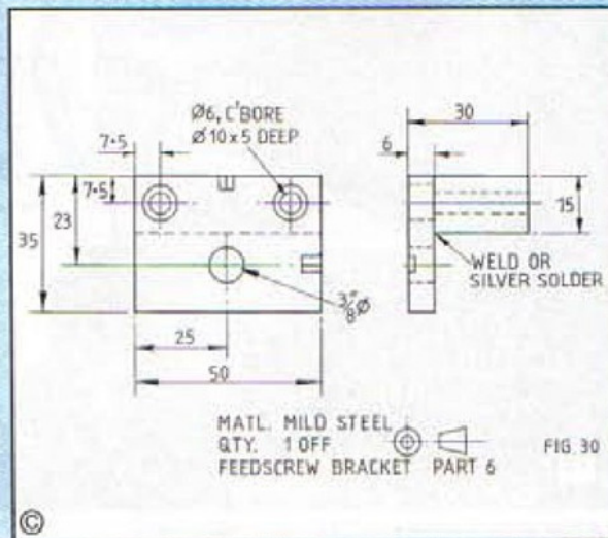
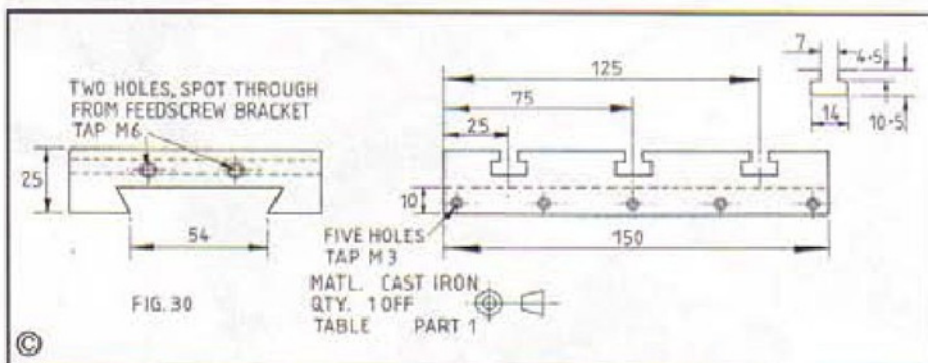


FIG. 30



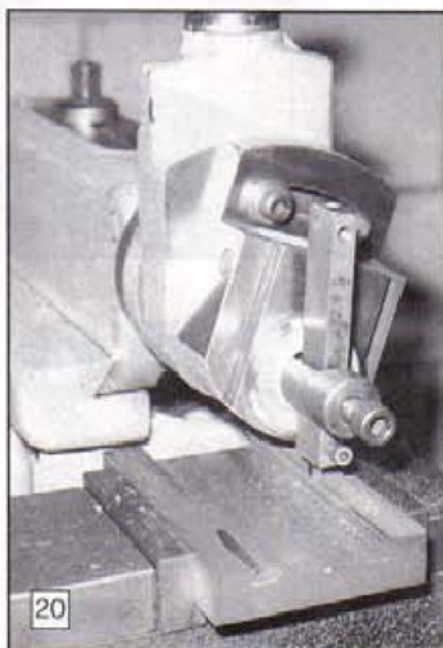
18: Lifting tool clear of work and applying feed on backstroke...



19: and releasing for next stroke.

A need for concentration

Engage the clutch and feed the tool down so that it just begins to scrape the bottom of the slot. Then have a few practice strokes to get into the rhythm in which at the end of the forward stroke you lift the tool post completely clear of the work (Fig. 18) and release it for the next (Fig. 19). (Can any reader suggest a method of doing this automatically - Ed?) When you have got into the rhythm, using the cross slide you start to feed the tool into the side of the slot to undercut the tee until you have cut up to the marking out. Then wind up the tool slide to finish the cross bar of the tee to size and zero the index so that you can finish the roof on both sides of all the tees to the same



20: Finishing cut to underside of table.

height. If you think you are about to lose concentration, hold the tool clear on forward and reverse strokes until you've retrieved enough concentration to switch off. Failure to do so will result in disaster as the tool attempts to lift clear on the return stroke, only to find the roof of the slot in the way, the resultant drag causing the tool to try to lift even further and dig in even deeper. This is positive feedback in its most noisy and destructive form.

When you have done one side of all the slots you simply turn the work around in the vice and do the other sides, taking care to set the tool slide to zero to finish the roof of the slots so that the load from the tee nut will be spread equally between the two sides.

When your nerves have settled down, break sharp edges with a file or scraper and put the table aside for a week or two for stresses to settle down, both in you and the casting! Machining the tee slots is likely to have released stresses so that the table bows slightly along its length so the time can be used to do some soothing turning of the feed screw and other parts. The table can then be set-up for a finishing cut of the dovetail and the underside of the table, done at the same setting to ensure parallelism of the four surfaces. Figure 20 shows a finishing cut of about 0.04mm being made with a broad tool of large end radius (Fig. 21). This gives an extremely fine finish on cast iron. All that remains to do is to clean up edges and fit other parts together. Although this is an article about the shaping machine, a few notes about the feed screw and thimble may be of

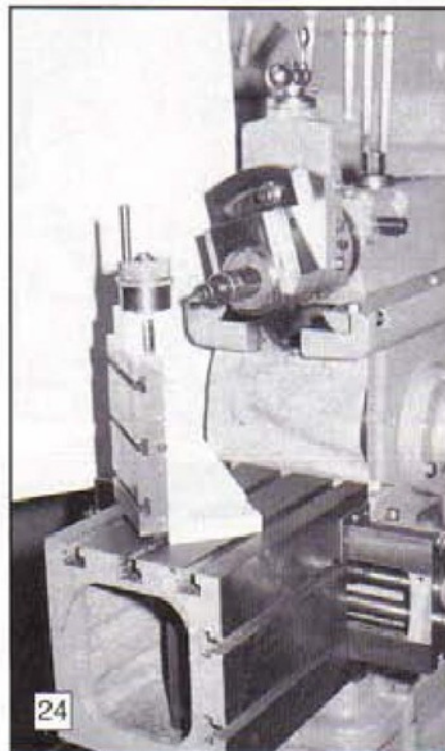


22: Exploded view of handwheel and thimble.

interest to turners and millers.

Making the handwheel and thimble is straightforward turning and Fig. 22 shows the internal construction. Over the years, I have made and encountered a wide variety of friction devices of various complexity. These have involved - "O" rings, springs, balls, pressure pads and screws, but this one is the simplest to construct and has a smooth positive feel to it without any play. A piece of alarm clock main spring fits in the groove shown and the thimble is wangled over the top together with a smear of thick oil. The length of the spring can be adjusted to give the feel required.

If you have got this far in workshop activities, making a 10 TPI or 2.5 mm pitch Acme form feed screw should hold no terrors, but making a nut for it is no easy business. It is a long and involved affair to make a set of taps in this size, so it really has to be screwcut. The tool has to be slimmer than the root diameter less the depth of the thread. Fig. 23 shows the ideal form of boring tool for the purpose. A 3mm dia. inserted cutter can be made from a broken drill or from silver steel ground in a cutter grinder such as the Quorn or at a pinch filed to size. Figure 24 shows the completed vertical slide.

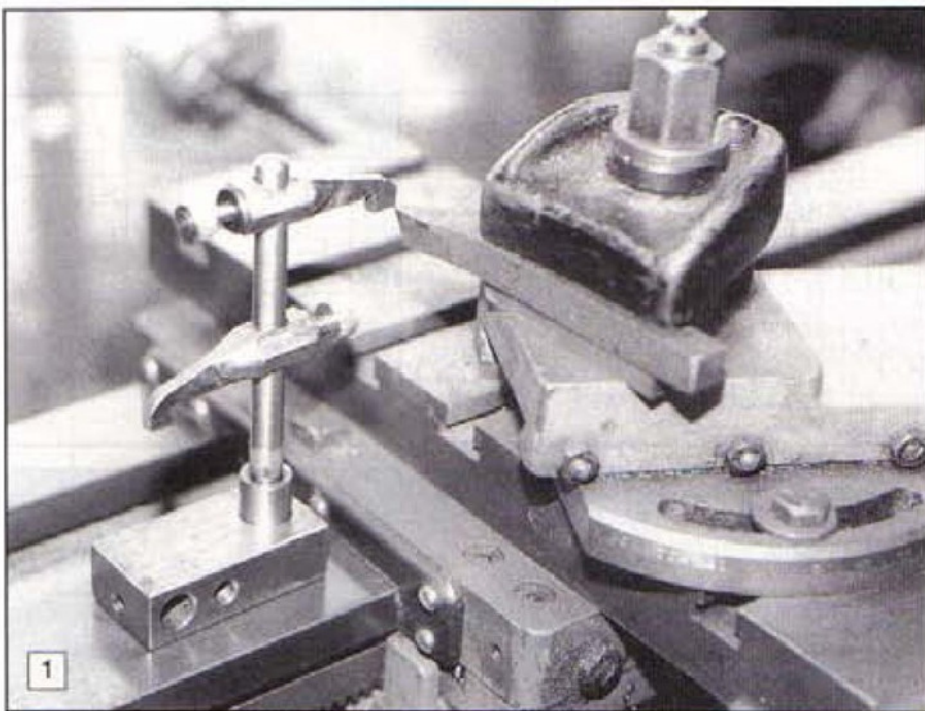


24: The completed slide standing on the shaping machine was used in its construction.

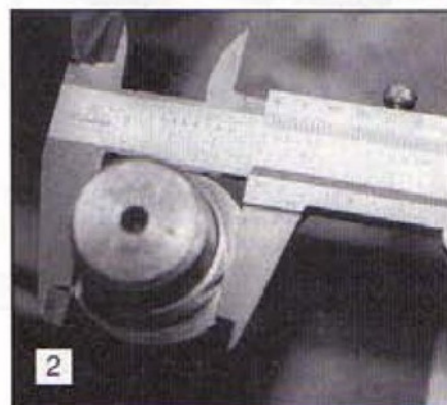
Many home workshops will have more than one lathe, or lathe and milling machine, each with its own set of accessories.

In this article, Derek Walters suggests making an adaptor for fitting chucks used on the Hobbymat BFE65 milling machine, onto a Myford Series Seven. This would equally work with items used on a Hobbymat MD65 lathe.

If these are not the machines you have in your workshop, do read on; the principle at least may be appropriate to your situation.

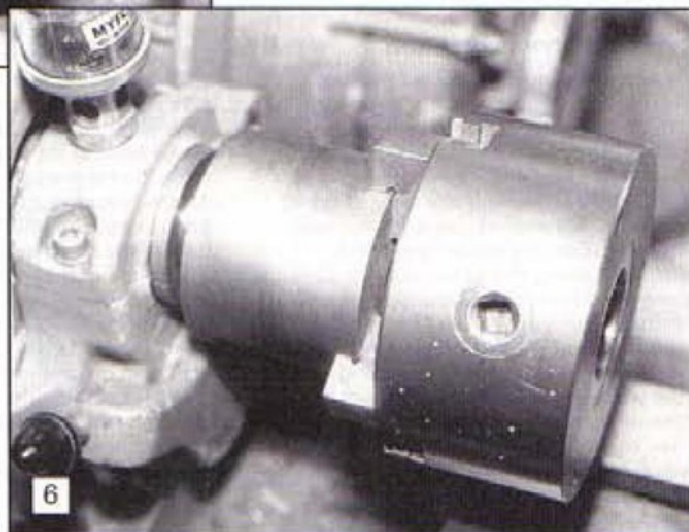


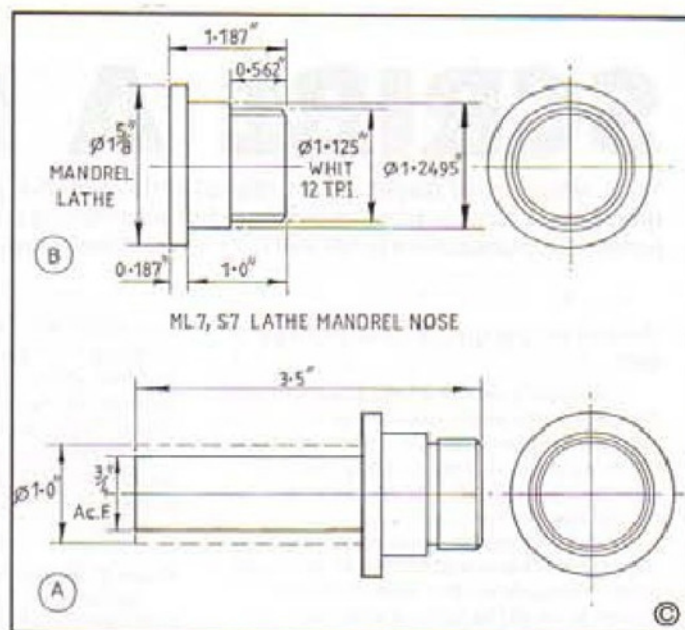
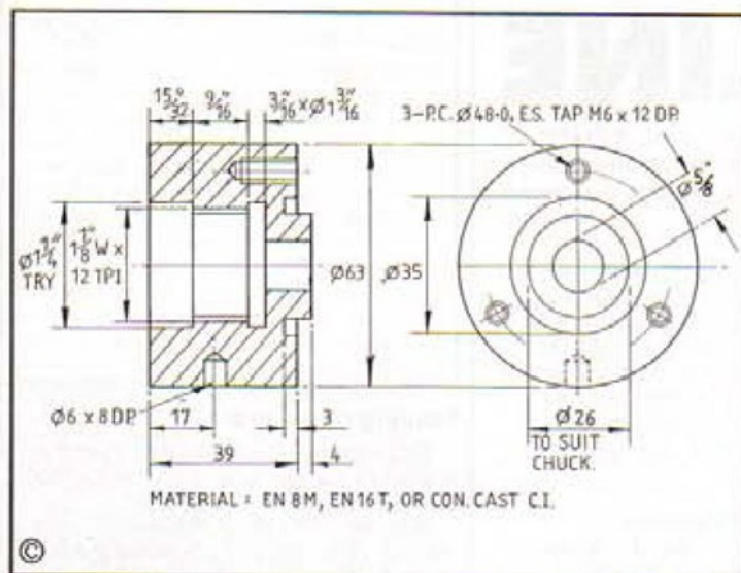
HOBBYMAT TO MYFORD ADAPTOR



Many owners of home workshops have both a Myford lathe and a Hobbymat mill, it is almost certain that you will have a collet chuck (not the 1MT chuck) with the mill and perhaps a flycutter, this adaptor allows you to use them on your lathe.

The end product will only be as accurate as you make it, so take extra care with it at all stages, also the gauge made can later be used to set up articles in the horizontal mode when it is clamped in the vice jaws and the faceplate fitted to it, this is so useful you will wonder how you scraped by without it. If you already have a Myford





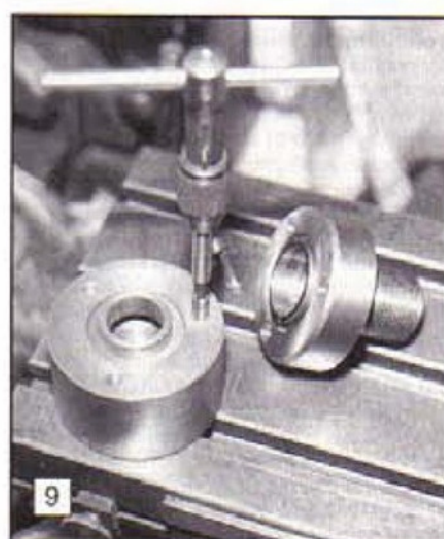
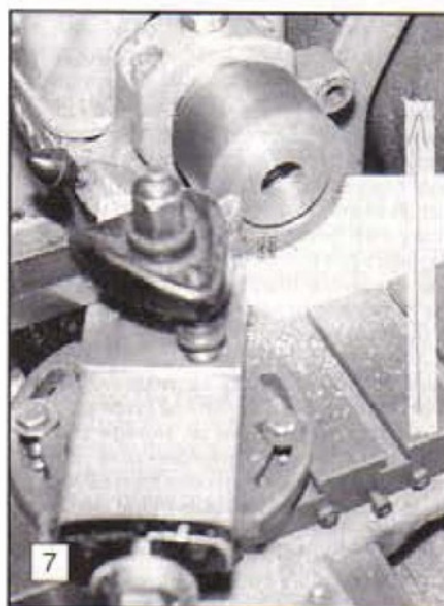
1434 chuck adaptor you can use this as gauge, but it is worth the extra time and effort to make the gauge-faceplate holder. Start with the gauge as shown on sketch 'A'. Use a piece of EN8M steel if possible, dia. 1 1/2 x 3 1/2 in. long, face over ends and turn down outer end to 1 in. dia. x 2 1/2 in. long, reverse in chuck and turn down to 1.249/1.250 in. x 1.0 in. long very fine finish. Then turn dia. 1.125 x 3/4 in. long and screwcut 1 1/2 in whit. form x 12 TPI, ensure that the screwcutting tool is sharp and set with centre height and screwcutting gauges; you can check it by trying on the catch plate this should be a good fit without slack. **Photo 1 and photo 2** show details.

The next operation is the milling of the two flats on the shank, which completes the gauge cum faceplate holder.

Check your own lathe nose which should be same as drawing before you start. It is advisable that all tools be used upon the lathe nose should be made from cast iron as this is less likely to "freeze" on the mandrel thread than steel. Centrifugally cast iron bar can be obtained from several suppliers in both M.E. and M.E.W. or from Williams Alexandra Foundry, Wentloog Road, Cardiff; they have a large scrap box of odd ends. Set up a piece of this bar dia. 65mm x 45mm long to clean up 45mm long, face over end and return to chuck jaws, reverse and face end and turn back over outside. **Photo 3.**

Centre drill to full dia., follow through with 1/8 in. dia. 2MT shank drill in tailstock right through. Bore out 1.020/1.022 in. dia. x 1 1/2 in. deep, recess backward as drawing 3/8 in. for thread runout. Use a tipped threading tool if possible, set to exact height with gauges, put gear train or gearbox to cut 12 TPI, set saddle auto-trip or pencil line on bed etc. and using 2nd. backgear speed cut your thread to the stub gauge, **Photo 4**, a tightish fit. Next bore the end of the thread out to 1.249/1.250 in. dia. x 1 1/2 in. deep, see **Photo 5**. This should also be a tightish fit. To be sure now try it on the lathe mandrel itself by leaving it in the chuck and unscrewing chuck from lathe, see **photo 6**, if removed at this stage it will be almost impossible to reset it. If OK then remove from chuck and put in barring hole as shown in the drawing.

Screw adaptor onto lathe mandrel nose,



turn register to be a tightish fit in your HobbyMat chuck register bore which should correspond with the register on the mill nose, then turn recess for the chuck, see **photos 7 & 8**.

Remove from lathe and fit collet chuck to adaptor with just two spots of Superglue, wait about ten minutes then spot through the three fixing holes 7.0mm dia. remove chuck by a sharp blow from a copper mallet, then drill the three holes 5.0 dia. x 15mm deep, tap M6x12mm deep as **photo 9**.

Blow out tapped holes, fit to lathe mandrel and chamfer both ends 1.5mm x 45 degrees. Lightly oil all surfaces as a finish and wipe with a rag.

Screws as supplied by HobbyMat with the chuck were M6 x 15mm which left only three threads outstanding. I consider this to be minimal, so I use M6 x 20. The completed adaptor and collet chuck fitted to a ML7B is seen in **photo 10**. T.I.R. (Total Indicator Reading) 25 from collet is 0.015 in. which is acceptable for my model work.

SCRIBE A LINE

Your views, your pages! Your opportunity to make your point, ask the question or simply pass on a snippet of interesting advice to others. Your letters for publication in *Model Engineers' Workshop* are always welcome

Domestic premises and storage of gas

The letter in *Scribe a Line*, page 11 issue 18, from Terry Gould, regarding the storage and use of gas on domestic premises, has resulted in some major differences of opinion, some of these are reproduced here.

In view of the confusion resulting, the moral from this would appear to be, if you intend going down this road, first seek advice from all the appropriate local agencies, and in writing.

From John M. Gurr of Wincanton

I phoned B.O.C. direct and put the question to them as to whether registration was required to obtain a gas cylinder. They had never heard of such a requirement and said that anyone could have any size of filling on completion of a hire agreement and direct debit form. They also referred me to the British Compressed Gases Association in case they could help, but they had not heard of this requirement either. They did tell me that a Fire Safety Certificate was required for any premises where five or more people were employed and where welding was carried out, but this is rather a different matter. They did, however, warn me that full application of the Pressure Systems and Transportable Gas Containers Regulations 1989 occurs on 1st July 1994, and this will involve users in a lot of paperwork and an annual stripdown and inspection by "a competent person", plus, of course, a fee! It was hinted, but not for publication as yet, that an exception might be made for single bottle users. I will let you know if and when I get any more on this.

I must add that gas cylinders can be very dangerous if improperly used and are not for the careless or slapdash. One local B.O.C. agent has a photograph of what appears to be a large piece of WWII exploded bomb casing, but is, in fact, the remains of a gas bottle which suffered a flash-back and exploded. In case the term is new to you, a flash-back is when the flame travels from the jet back through the torch and down the tube to the cylinder, it can happen for several reasons, among them incorrect gas pressures or a momentarily blocked jet causing a backfire. Hose check valves, (spring loaded one way valves), minimise the risk but flash-backs can travel faster than the valve can operate and the only safe answer is to fit Flash-back Arrestors in each tube. The simplest, and cheapest, is fitted to the torch and consists of a flame filter, (Davey lamp principle), followed by a check valve, but this does not cover accidents where the hose gets burnt or cut and gas escapes and ignites. This can be covered by a much more expensive version which fits on the cylinder outlet and has, in effect, a fusible plug which melts instantly and shuts off the gas flow. After this you throw it away and buy another! The top model, (very expensive!),

also fits to the cylinder but can be reset. We all know that fuel gases can be dangerous, but how many realise that Oxygen can be as well? To quote the B.O.C. Oxygen Data Sheet "Vigorously supports combustion of many materials which do not normally burn in air. Highly dangerous with oil, greases, tarry substances and many plastics."

From T. Burgess of Farnham

Re the letter by Terry Gould in *Scribe a Line* issue 18 about storage of gases.

He stated that you need to be registered before you can get a gas bottle or get one filled.

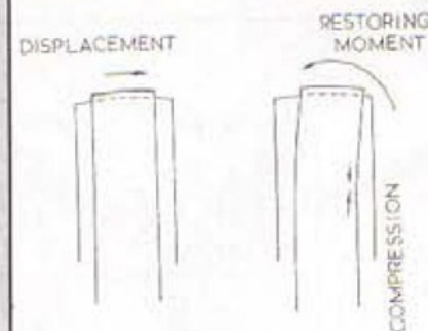
I have contacted my local fire service who said if it's for your own use i.e. for a hobby and not for any business and I do not employ anyone to operate the equipment they are not interested. They only inspect industrial premises they do not do residential inspections and what I do in my own home is up to me. They did suggest I got in touch with my local Environmental Health Officer to see what the H.S.E. has to say about storage and use of gases in residential premises.

This I did, the reply from them was the same as the fire service i.e. what I did in my own home was up to me and I was also told that the regulations on storage of L.P.G. in commercial premises only came into force if you stored more than 50 Kg. the only comment that was made was to secure the gas bottles so they did not fall over and damage the valves.

I contacted my house insurers and told them that I keep a 19 KG. Propane gas bottle and I am contemplating purchasing a small size gas welding equipment (Oxy-Acetylene) and the gas is now stored in a three sided brick hearth with a wooden felted roof with an inch air gap all round the top and the open side left open so no gas can build up inside (in fact it is my brick garden B.B.Q. which doubles as a brazing hearth and gas store). This is 8ft. from the boundary fence, 8ft. from the workshop and 8ft. 6ins. from the corners of the house. There is a 1.5 Kg. dry powder fire extinguisher just inside the workshop door and a second extinguisher again 1.5 Kg. just inside the garage. Their reply was the same as the other two inquiries, that if it was for my own use i.e. for my hobby and not for any business it did not infringe my house insurance or my fire cover.

I next contacted my local gas supplier who said they had never heard of anyone needing to be registered to keep gases on their premises. As far as they are concerned you go into the shop, pay for the gas bottle rental by direct debit then pay for the gas in a bottle and take it away. As they put it "just like hiring a car".

The last word when leaving the fire station was from the watch commander, who stated that every backstreet garage, of which 9 out of 10 are only glorified wooden sheds, have Oxy-acetylene equipment and they do not have to be registered to keep it.



Staying on course

This letter from John Freed of Thornbury, is one of a number answering the question posed by Terry Gould in issue 22.

In *Scribe a line* in the March/April issue (No. 22) Terry Gould of Shrewsbury asks how a blade or belt stays on a crowned wheel. The short answer is that the system is self stabilising due to the stiffness of the belt. (ref. The Theory of Machines by R.F. McKay published by Edward Arnold 1915).

The restoring force is provided by the deflection of the belt, as shown in the sketch. The side in the direction of the displacement is put into compression, and the opposite side in tension. The induced strains result in a restoring moment.

Calculation and testing would take longer than the manufacture of the wheels, so Terry Gould no doubt resorted to the perfectly legitimate procedure of "trial and error".

I must say that seeing the photograph of his finished machine has spurred me on to make one too.

In my mind as long as people are sensible about the use and storage of gases I don't think we in this hobby have a lot to worry about.

Some further comments from Terry Gould

I have received a letter from a reader in Warrington, his main reason for writing was not the matter of gas, which was included as a footnote. The main subject was balancing, issue 17 Woodplaner.

Going back to my letter, issue 18, what I should have included as one reader from Warrington, who has had a similar problem, has pointed out, and quite rightly, is the size and quantity being referred to, which as read included all sizes of Oxygen and Acetylene. The author of this letter seems to have taken it that this also included LPG. I said in my original letter, other than domestic or butane. I was referring to the ones I use, oxygen acetylene, and nitrous oxide.

The size of bottle should have been included. Size N for Oxygen 63 kg. Size F for Acetylene 88 kg. The reader also points out you are only entered on a register as owner/occupier of a domestic dwelling when inflammable gases are kept in excess of H.S.E. and also adds this does not apply to all areas within the U.K.

I would like to thank Alan from Warrington, who did not supply an address, for the information, and the tips on insurance. I think you should get in touch with our Editor of M.E.W., as you have much to offer the readers.

Buyer beware

Jim Edney of Armadale, Australia, writes regarding some poor quality bench grinders. I would bring to your attention the quality, or rather the lack of it, with respect to two Bench Grinders of Asian origin. The safety aspect rather frightens me, even the most lowly apprentice in an engineering shop would be very aware of the safety points or lack of them in these units.

The first a 200mm Bench Grinder, had a shaft approx. 1/4in. parallel with a groove plunge cut with a parting tool, to allow a small circlip to act as a retainer for the loose fitted, pressed metal cheek plate, which acts as the fixed cheek plate. The retaining nut in this case was so much out of truth that it was almost a joke, the face was almost 1mm out of line, the nut when tight would not secure the wheel.

The wheel had a lateral run out of almost 6mm with an eccentric runout of about half that. My neighbour, the proud owner, went to switch it on to show me the "wheel wobble". I fled his shop, yelling to turn it off. On my advice he returned it to the retailer, who could find no fault with it.

He insisted on another unit, this time of another make. He called me into show me that the wheels ran true. They did, in fact. However, I put my fingers on the work piece rest, between thumb and forefinger was able to bend the rest quite easily to the extent that the gap, wheel face to rest increased from about 1mm to at least 6mm.

Anyone who has seen a grinding wheel explode will be aware of the possible result to life and limb, yet people responsible seem to take this as a minor incident.

I would bring this to the attention of professional and model engineers around the world, people of professional integrity who are aware of the possible tragedy that can happen, when we sell our previous high engineering standards for the sake of money.

Now retired, I enjoy a shop set up with a 9in. Hercus Craftsman - virtually a South Bend Lathe, a horizontal Mill, 22x7in. bed/table. And various other goodies. Building and experimenting with Gem facetting machines. Just made a windmill for the back yard, 10ft. tower with a 3ft. wheel. Geared head, operating a 1in. bore, 3in. stroke water pump.

Hoping this small contribution will help to increase awareness of the need to be forever watchful of the standards of machines appearing on the market. The need to bring those to heel, who are responsible for setting out standards of safety.

Thanking you,

(Jim did include the names of the different grinders, but readers will, I am sure, appreciate that I cannot publish these on the strength of one letter alone, in particular when not having seen the machines either. Grinders may not be the most used machines in the workshop, but once may be too often. So do pay attention to the safety aspects of such machines before switching on, even before purchasing if not buying by mail order-Ed.)

Successful beginner, one of many!

Peter Annely of Leeds encourages other beginners to have a go

In the hope that it won't be too boring, or basic, I offer the following jottings as an encouragement to other beginners, like myself.

Having spent the past 30 years in the Business/commercial area hands on mechanical engineering was not a likely progression. However, a friend gave me the book *Using the Small Lathe* by Mr L.C. Mason and I was hooked. I can't explain why, (all folk from Lancashire are indigenous engineers?), whatever, it's taken over my life.

I first read the book just over two years ago and apart from being full of sound advice, it serves as a text book for me.

One morning at breakfast to my wife, "I've gotta have a lathe dear". She murmured "Why not. Doesn't everyone have one these days", and so, with this approval given I set to scouring the mags. and ended up with a new Hobbymat MD65. In some ways this was a mistake. The MD65 is very small and, I now know that I should have looked at the secondhand market. Having said all that I really did enjoy using the MD65. It's a fine, precision tool and well made.

I became really attached to it and it to me, judging by the number of times it bit pieces out of my hand, one way or another.

I did learn all the basic skills on it. I turned perfectly good round bar stock into oval pins. I made threads not yet in the tables. I had milling cutters and drills fragmenting like World War II. Oh, the joy, but I was learning, and soon was able to operate the machine to a reasonable standard. It was with not a little sorrow that I recently parted with it to make way for the Myford ML10.

I am now in sheer heaven. Tee slots on the cross slide, what more could anybody want? An extra inch of centre height!!! Sheer bliss. The biggest bonus is that I can now go back to issue No. 1 of "The Mag." and make all those tools that, hitherto, I hadn't the capacity for. All the while the learning process continues.

My workshop is the garage attachment to the house. The machinery content is rather meagre: the lathe, a bench drill (which I perform light milling on), a 5in. grinder and drill B&D power drills and their attachments. I'm currently building up a collection of files, drills and mills and cutters generally.

To date I have made the following equipment:- Four way tool post, Rear tool

post, Ball turning att., Knurling tool, Fixed and travelling steadies, Tailstock lever feed att., Various MT2 tapers, centres and jump up sleeves, Fly cutters, and odd 'D' bits, mills and slabs. I am reasonably happy with the standard of finish I can achieve but keep on striving for better.

My next venture will be into the realms of dividing. I feel confident enough to attempt this now and I shall be making an addition for the Myford.

I apologise to the experienced ones amongst you for this very basic diatribe, however, I guess that there are many out there who, like me, are just starting. My advice would be to keep on practising, read as much as you can, don't miss out on *Model Engineers' Workshop* magazine and, above all, persevere. Cost is a major factor and most of us work on a tight budget. Car boot sales and auctions are a wonderful source of "bits and pieces" and it's amazing what your neighbour may have in his garage which is of no use to him.

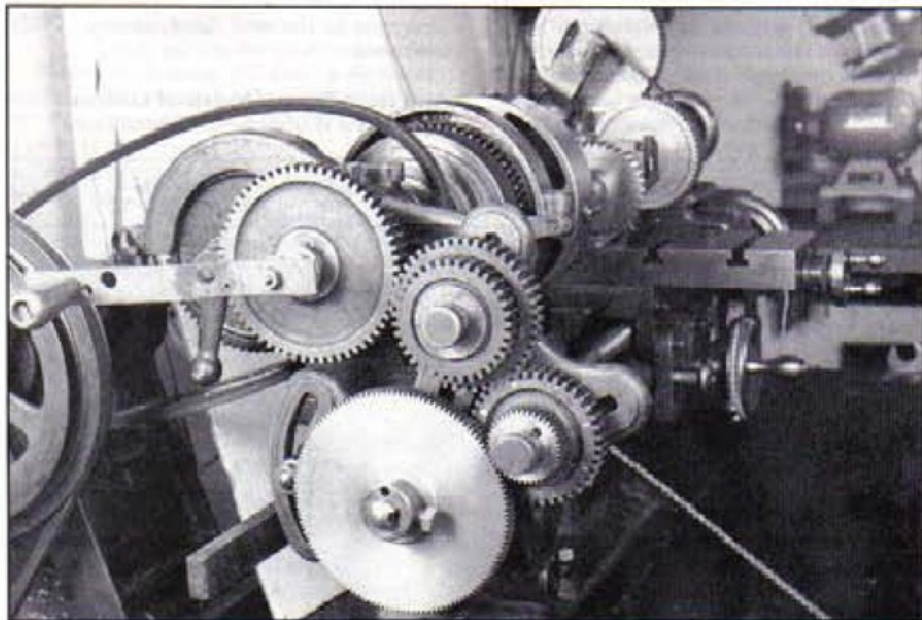
Dirty hands are another problem. There has been a lot of comment about various means of hand cleaning but I find that prevention is better than cure. The barrier cream that Chronos sell (PR88) is excellent. It's expensive, but economical and well worth it.

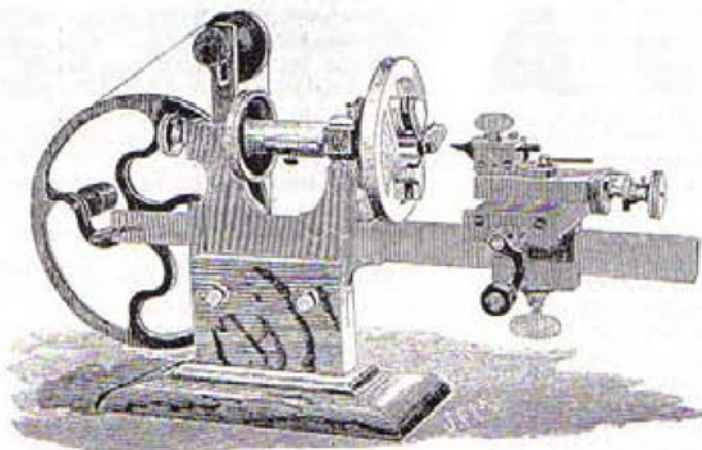
A case of Lateral Thinking

From Tony Skinner of Glasgow comes this excellent idea for cutting precise metric threads on lathes with imperial leadscrews.

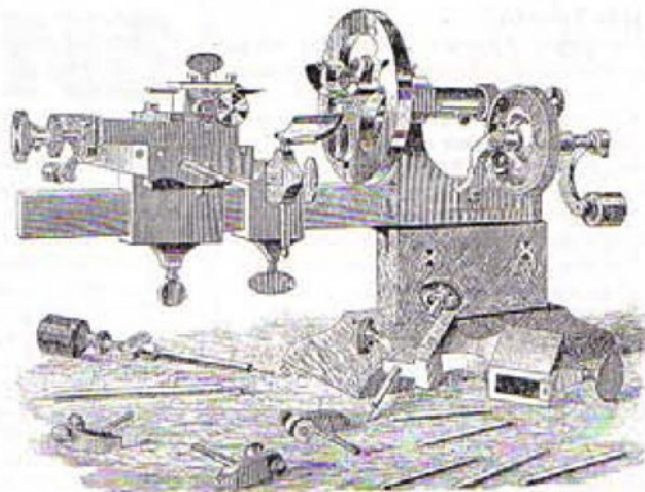
I much agree with the letter from Mr Shenton in Issue 22, on the inclusion of a 127 tooth gear to lathe-cut metric screw threads. However, a 127 tooth gear of the same pitch as the standard gears for the lathe can be inconveniently, or impossibly, large to mount on the lathe, apart from the difficulty of dividing that number in order to cut that gear oneself.

Can I offer an alternative solution to these problems. This is to include in the gear train a pair of gears which include one of 127 teeth, but of smaller pitch and commercial manufacture. My lathe is an old, but still very versatile, Myford "M" (ex Drummond 3 1/4in. flat bed). I bought three gears from The Davall Gear Co. Ltd., of Welham Green, Hatfield, Herts, AL9 7JB





Anglo-Swiss mandrel and slide rest



Swiss mandrel

(who have advertised recently in M.E., including note of their excellent catalogue, well worth its price of £4.99). These gears were a 40 tooth, an 80 tooth and a 127 tooth, all of 1.0 module, giving the 127 gear an od. of 129mm (5.08in.). Also these gears had a face width of 15mm, which allowed easy matching to the existing gears. These gears were bored out and fitted with coupling pins to suit the existing lathe fittings. The 127 tooth gear is used on the leadscrew as shown in the photo, and driven by either the 40, or 80, tooth same-pitch gear as convenient, whilst the rest of the gear train uses the existing lathe gears. The table then gives the gear trains for the common metric pitches for the leadscrew of 1/in. pitch, and for non-gearbox lathes. Note of course that, according to the number of gear pairs used, an idler gear may need to be included to obtain right hand threads. Clearly another pitch could be used for these conversion gears if such gave more convenient diameters.

The boring out of these gears was done some considerable time ago, but my recollection is that, at that time, I was not clear as to what surfaces of the bought gear should be used as reference in setting up, in order that the gear runs true after boring out, and this caused me a bit of difficulty. However, on contacting Davall for this letter, they say that one should set up to have the bore and the plain face (i.e. that without the boss) run true. If it is essential to have the boss face outwards for boring, they say it might be advisable to trim this face by mounting the gear on a tapered mandrel and just skimming it true.

Anglo-Swiss Mandrel

We publish three letters on the subject of Gerhard Gunnarsson's lathe seen in *Scribe a Line*, issue 22. These taken from a large number of letters received. This one from M. Chase of Coventry

Re the letter in your March issue from Mr Gunnarsson of Sweden with the photograph of his ancient lathe.

I had a similar machine many years ago, my own in solid brass, these lathes were used for working on Pocket Watch Movement Plates, Dials, etc.

The watch plates were first drilled out with all the pivot location holes on a drilling machine. Then, for such as the mainspring barrel, the plate was put on to the lathe face plate, and the clamps nipped in to hold the plate.

The headstock centre of the lathe, slides inside the straight bore, (no Morse taper here). This centre is spring loaded, and fitted with a bolt to hold it within the headstock.

The spring loaded centre is then released into the back of the hole to true this hole concentric to the spindle. Clamps then tightened, centre withdrawn, toolbit into slide toolholder and hole counterbored, used on locations for the mainspring barrel, also on dials where the offset seconds position would be sunk to a suitable depth, the diameter to allow the seconds hand to revolve, and provide clearance for the hour hand passing overhead.

And from Dennis Naish of London

This is a Watchmaker's Mandril or

Mandrel, ie a "lathe having a face plate furnished with dogs for clipping watch plates and the like, and having a spring centre (pump centre) in the face plate." See Britten's Watch and Clock Maker's Handbook; I send you a photocopy of part of the 13th edition which I happen to have.

GC's seems to be Britten's "Anglo-Swiss" variety.

I suppose these nice things went out of use at about the same time as the Clockmaker's Turns, when small centre lathes (which could do everything that the mandril and the turns could do) became cheaper.

And from J. Burns of Cleethorpes

On looking up some old M.E.s of 1956 era I find the same queries on the machine on page 68 in *Scribe a line* under title Postbag, 19 July 56, this showing virtually some machine, and in 16 Aug 56 an explanation of its origin, in France.

I have no interest in collecting any antique machines, being a UK pensioner but I thought you will be interested in its previous history. I do not have many old M.E.'s so pure chance it is in the ones I have.

Further CAD programmes would be of interest to me with bargain suppliers of machines.

Peatol article appreciation

From Andrew Middleton of Tasmania comes this letter of appreciation for the article on the Peatol dividing head in issues 21 and 22.

Thank you for the article on the dividing head for the Peatol lathe, which is available in Australia as the Taig II Micro Lathe. It is made in the USA, and at least two suppliers exist — one in Victoria and one in NSW, but there may be more.

The lathe is a good, robust little plain lathe, and only one thing has failed in the three years I have had mine. The use of a rack and pinion drive for the slide instead of a leadscrew means that powerfeed is not possible, although the supplier I bought mine from said that the manufacturer was planning to bring out a powerfeed attachment sometime in 1991. So far I have heard nothing more about it.

At one time, I had a failure of the rack pinion gear — several gear teeth stripped off due to swarf getting on the rack. The supplier sent me a new gear plus a strip of black plastic material which fitted behind and overhanging the rack to prevent

Metric Pitch required, mm	Final drive, 40 driving 127	Final drive, 80 driving 127
0.4	20 drive 50	
0.45	45 drive 50, 30 drive 60	
0.5	20 drive 40, 30 drive 60	
0.6	30 drive 50	
0.7	35 drive 50	
0.75	30 drive 40	
0.8	40 drive 50	
1.0	30 drive 30	30 drive 60
1.25	50 drive 40	
1.5	60 drive 40	
1.75	35 drive 20	
2.0	60 drive 30	30 drive 30
2.5		50 drive 40
3.0		60 drive 40

similar incidents in the future. It is held in place with a strip of double sided tape.

I am interested in Tony Jeffree's method of adjusting the drive belt, as the motor is not supplied with the lathe, the purchaser to find a suitable one. In my case a friend sold me a 2nd hand washing machine motor with the correct shaft diameter. To tension the belt, I have mounted the motor on a block of 12mm plywood with two lengths of bicycle chain. The block of ply slides in wooden guides, being wound back with a length of threaded rod to tighten the drive belt. The weight of the motor alone is sufficient to keep the belt tight when adjusted to a new setting. It looks a bit crude, but does the job well. One advantage is that the motor can be carried separately, a considerable advantage when shifting the lathe. My motor is mounted to the left and rear of the headstock, as it rotates in the reverse of Tony's. Naturally, I ordered the wrong wooden base for my lathe as I was told that a motor rotating in the direction mine does is not common. A new base then had to be made. At least it then made the tensioning method described possible.

Am looking forward to the next part of the article, and hope to see more articles about plain lathes in MEW. My lathe is used to make small bushings, wheels and other parts for my 1:48 scale (1/4in. - 1ft.) S gauge model tramway hobby. So far I have made only one tool — a metal cutter with a built-in and adjustable edge guide.

Tony's description on Dividing head theory was very helpful — I have never sucked this particular egg at all! There are a lot of us out here and there who are complete novices and welcome clear explanations of seemingly well understood theory. As a former bank officer and now minister of religion with no background in machining or metalwork, any article such as Tony's is of great benefit.

Covers for workshop equipment

This letter from A.M. Humphrey of Chorleywood.

A range of plastic covers is widely available for the protection of garden furniture etc. These covers are well made, strong, water-proof, durable and cheap. They come in a variety of sizes, but a particularly useful one is described as a 'kit bag' and is 30in. diameter x 43in. long. This is a perfect fit for Taiwanese mill-drills and fully covers all parts including the base and compound tools. In my own case I have found that a 50 watt electric heater kept on the compound table is enough to maintain an inner temperature several degrees higher than ambient.

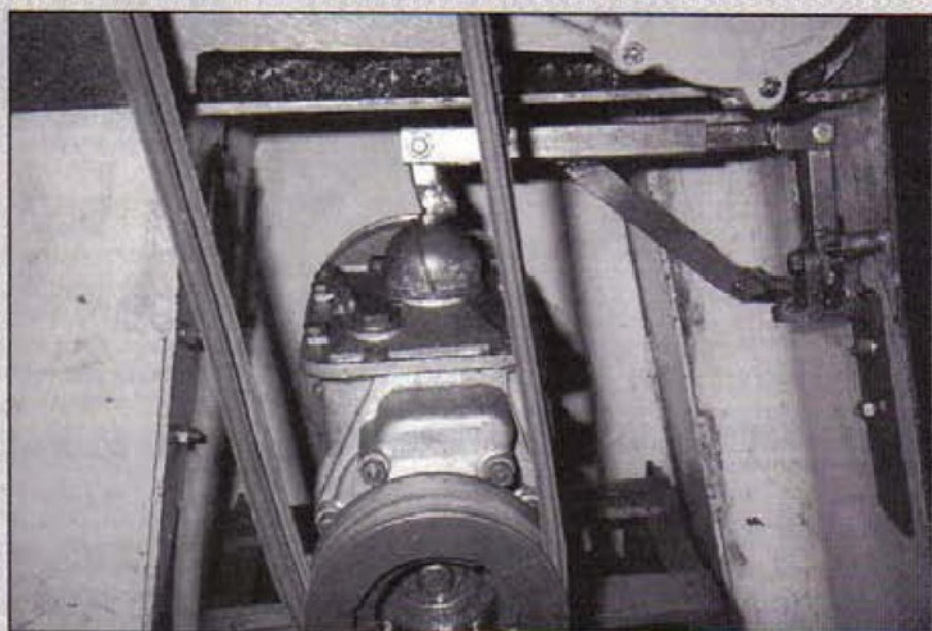
This is very effective for keeping rust at bay and I have taken to storing other rust sensitive items and equipment on the table inside the 'hot air balloon'.

Drummond Lathe Manuals

From John Noonan of Days Bay New Zealand, comes this suggestion for a source of Drummond lathe manuals.

The issue of Drummond Lathes (page 690) refuses to lie down. It has already been established that the company was taken over by Myfords and that spare parts have not been available for some years. Information is said to be unobtainable.

I have with me the December 1993 book



Gearbox for a Chipmaster

Aubrey Blake of Bournemouth suggests using a motor car gear box in a lathe drive system.

With reference to your recent letter re Chipmaster lathes, I have been using mine for the last 3 years, fitted with a 1 horsepower motor.

The variator drive was replaced by a four speed gearbox from a Reliant Robin! The motor is 1425 rpm and fitted with a 4in. pulley, the gearbox pulley is 6 1/2 inches.

It has run perfectly well since I have had it, and has plenty of power.

May I express my sincere appreciation and thanks to all the readers (about 20) who contacted me in response to my request for help (in the March/April issue of MEW), concerning operation of the EW Lathe.

The response was truly overwhelming, and I received many readers' calls from all over Britain, many of whom have kindly sent me charts and literature and given very helpful advice.

My introduction to "metal-bashing" has been a very pleasant experience and I am only just beginning to realise what I have been missing over the past 40 years!

Thank you everyone for your warm response and friendly advice.

list issued by Plough Book Sales which included:

003305 Drummond Type M Lathe

003306 Drummond Lathe Work

003307 Drummond A Type

Cylindrical Bed Model Makers Lathe
Plough Book Sales, PO Box 14, Belmont,
Victoria 3216, Australia. Phone: (052) 661
262 Fax: International + 6152 2177 83. Fax
is remote so answers take time.

Perhaps I should add that in this country British Postal Orders are not accepted — the clearance costs are prohibitive and I believe that the same applies in Australia.

Trusting that I have been of assistance.

(The manuals mentioned in this letter apparently originate from TEE, which would be a more appropriate source for some readers. However, the Plough Books catalogue contains an amazing list of over 2000 titles, mostly relating to old machinery and with particular emphasis on agricultural machines and the like. - Ed.)

Link up working

A letter of appreciation from I.C. Hayward of Milsea. Is there scope for an E.W. owners circle?

Countersinking diameters

Ninety degree countersinks for slotted head countersunk screws can be machined using the following formula:

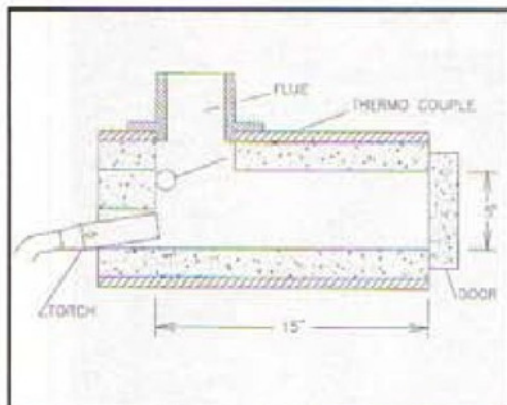
Max head of metric screws

= screw dia. x 2

Max head of Imperial screws

= screw dia. x 1.75

Alan Jeeves



Furnace temperature

Can anyone help Doug Hall of Ninderry, Australia with the design for his muffle furnace?

I am having a problem in my workshop. I have built a muffle furnace, the inside dimensions 6in. x 5in. x 15in. with a fusebrick lining 3in. thick on the outside, 1in. thick ceramic fibre. This is enclosed in a sheet metal cover. The flue is 2in. inside dia. and I have a digital pyrometer to check temperature. I have fitted a Sievert torch with the biggest nozzle they supply through a 12in. diameter hole in the rear. Unfortunately I cannot get a very high temperature.

So — do I need bigger gas burners, or — can I open up the jet and further how can I work out how much gas I need? I use propane.

I was rather proud of my job until I could not reach 850 deg. C which is needed for hardening.

I would be very much obliged if someone could help me, incidentally I am 74 and I have had M.E. off and on since I was 14.

Material hazards

Following the articles on materials in recent issues two letters have been received regarding the safety considerations in the use of some of them. This first letter from R. Jolley of Hebburn on Tyne.

Further to the article in issue 22 page 59 I would like to add some comment, especially with regard to safety. The most lethal is P.T.F.E. It being a member of the Thermal Plastics family on all of which technical warnings have been issued.

P.T.F.E. if allowed to heat above 288deg. C decomposes and creates a nausea. If the toxic gas mixes with tobacco smoke "phosgene gas" is generated.

Polystyrene when manufactured and/or overheated whilst moulding emits "Styrene Gas" which is sickly.

Kemetal when overheated emits, if blow back is allowed, "tear gas". Another warning was issued in the Institute of Electricians monthly journal, some time in the late 60s.

Beryllium Copper Quote:- If one is cut, whilst handling this material the incident must be recorded in the company's first aid

records. Thrombosis occurs from the cut some 20 years on. True, I have it and three others I worked with have it as well.

And from G. Siddall of Luddendenfoot

Mr Loader refers to a special technical instruction circulated about the safety aspect of using P.T.F.E. which referred to the toxic fumes given off by this material. The following may give some indication of the reason for this instruction.

I recall a conversation I had some years ago with an employee of a firm manufacturing this material in Lancashire. He informed me that they had been having a number of workers at the factory who collapsed with very distressing symptoms. The strangeness of the sudden illnesses was the fact that they did not all occur in the factory, and the solution tended to be puzzling.

Eventually it was decided that the cause of the illness was minute particles of P.T.F.E. on the end of cigarettes which when lit produced the toxic fumes which caused the trouble. The factory supplied various special turned items, and therefore some small turnings were produced.

It is unlikely that the amateur would be exposed to this, but it does show the way in which toxic fumes can be concentrated by drawing them through a cigarette tube.

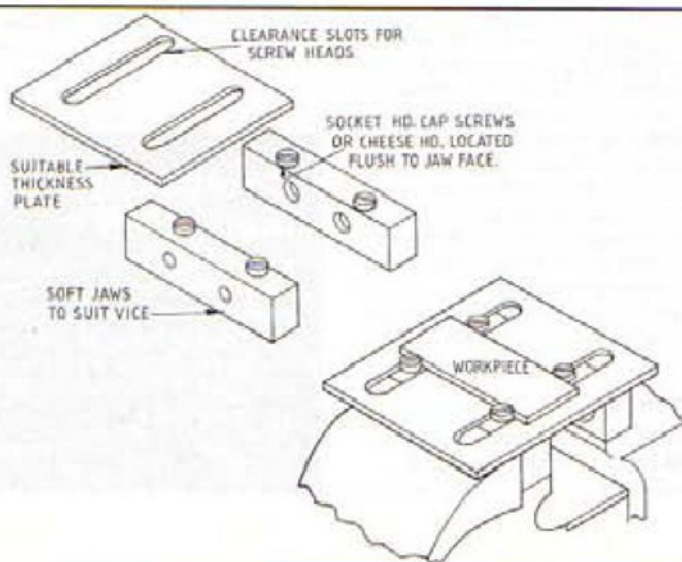
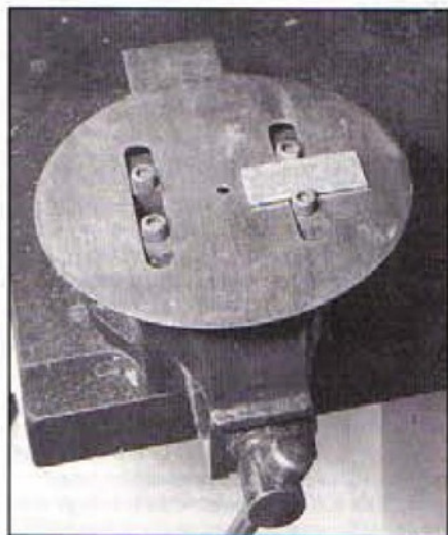
This conversation took place a number of years ago, and may have been the reason for the original instruction, but I have no knowledge of any further information. No doubt other readers may have more up to date details.

THIN PIECE VICE ACCESSORY

Alan Cambridge provides us with this bench vice accessory to assist with the holding of thin workpieces.

Holding thin items for working on, be it filing, drilling with a hand drill, or even marking out, can be a problem, especially if the item is quite small. The simple device that I describe here will go some way to minimising the problem, and

is simple and quick to make. Whilst the illustration shows it holding a simple strip, it is capable of holding other shapes, circles for instance. A third slot, and additional pairs of screws, would enable smaller items to be gripped; by fitting only those



screws required, the range of items that could be held would be further extended.

Construction is easy and there is little that need be said. Make some soft jaws for the vice and fit cap or cheese head screws, these screws can have their heads turned in the lathe so as to have good sharp corners, thus helping to ensure a good grip. It occurs to me that the grip may be further improved if the heads were turned with a slight taper, being larger at the outer end.

The actual feel for gripping any thickness of material is excellent. In most cases just the weight of the vice handle is enough to grip the thinnest material.

If the need arises to file thin material, then packing up under the plate with washers seems to be the answer.

